EXPLORING READING AND MATHEMATICS INTEGRATION IN PRESCHOOL-AGED CHILDREN

A Dissertation

by

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ABSTRACT

The purpose of this dissertation was to add further support to the claim that concurrent reading and mathematics instruction with young children could not only prove to be symbiotic in nature but also could provide a potential for increased intellectual capital. The research for this dissertation was conducted in a three-study format. The first study was a meta-synthesis. This method of gathering information was chosen because it provided the researcher the opportunity to discover what previous research had already been conducted on the effects of using reading and mathematics instruction concurrently with young children. The results of this meta-synthesis indicated that although that type of symbiotic instruction is gathering research interest on an international level, the effects of such an instructional method in a domestic setting are still largely unknown due to a lack of studies on reading and mathematics concurrent instruction in the United States. This indicated that further research was needed. The second study began with the development of a reading and mathematics instructional four-part intervention. The four-part intervention was then introduced to a small group of parent volunteers whose children attended a private, suburban daycare center over a four-week period. After completing the four-part intervention series, parents provided overwhelmingly positive responses concerning the effects of the reading and mathematics intervention, citing an increase in their child(ren)'s expressive mathematics vocabulary as well as an increased awareness in how to incorporate both reading and mathematics into their home environments. The third study applied the same developed reading and mathematics concurrent intervention in two different daycare settings-one

suburban and one urban-in order to determine if it was an effective instructional tool in early childhood classrooms. Although teacher participation was limited at both sites, the data gathered therein provided further evidence of the benefits of concurrent reading and mathematics instructional intervention on young children. Thus, this dissertation serves as a foundational record of the need for more studies involving the effects of reading and mathematics concurrent instruction. Furthermore, this dissertation provides limited positive effects of utilizing concurrent reading and mathematics instructional interventions with young children.

DEDICATION

For my sons.

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CHAPTER I

INTRODUCTION

Statement of the Problem

Mathematics and reading have consistently formed the foundation of educational curricula in the United States. Still, students in the U.S. rank lower than other industrialized nations in reading and mathematics in the Programme for International Student Assessment (Organization for Economic Co-Operation and Development [OECD], 2004, 2013). Furthermore, the U.S. ranked 18 out of 40 participating countries in reading, but 28th in mathematics and 29th in problem solving. Students' understanding of mathematics concepts are inextricably bound to their capabilities in word recognition, text structure, and mastery of content vocabulary that is used to define, represent and communicate the mathematical concepts (Piccolo, Harbaugh, Carter, Capraro, & Capraro, 2008). It follows that the earlier a child can be exposed to mathematics vocabulary, the easier mathematics vocabulary acquisition and understanding can be for that child. This process includes enhancing the child's foundational vocabulary as well as his or her understanding of early mathematics. This symbiotic form of early learning could result in an increase of potential future academic achievement. In a joint position statement by The National Association for the Education of Young Children and the National Council of Teachers of Mathematics (2002), it was suggested that integrated, intentional curriculum can effectively introduce children to skills that can nurture both reading and mathematical development. Therefore, further exploration is needed into

how to apply that kind of symbiotic curriculum in order to foster both reading and mathematics instruction concurrently.

Operational definitions based on this dissertation are as follows:

1. *Symbiotic intervention* will refer to a series of four lessons that integrate both reading and mathematics in a concurrent, symbiotic way that allows for and aids in the development of both reading and mathematics.
2. *Dialogic reading* will be used when referencing a style of reading that adults can use with children while reading storybooks. This style of reading involves the adult prompting dialogue from the child by using scaffolding methods to question the child about their understanding of the story being read (Whitehurst, Falco, Lonigan, Fischel, DeBaryshe, Valdez-Menchaca, & Caulfield, 1988).
3. *Bioecological* is a term that refers to the biology and environment that makes up and surrounds an individual; in other words: the place (physically and biologically) that one is situated in. This consideration of both biology and "place" is critical to an individual's continual development (Bronfenbrenner, 1994).
4. *Effortful control* will refer to an individual's ability to sit still, focus, and complete a task (Rupley & Willson, 1991).

5. Pygmalion Effect will refer to the theory that a child will adjust his or her behavior based on the expectations for behavior that are outlined by an adult in his or her life (Rosenthal & Jacobson, 1968, 1992).

Purpose of the Dissertation

The purpose of this dissertation was to explore how integrating reading and mathematics foundational concepts in a symbiotic intervention could pique preschoolers' interest and understanding in both reading and their understanding of early mathematics vocabulary. The goal of conducting this research was to add further evidence to a growing body of research supporting the use of symbiotic reading and mathematics instruction. This series of studies utilized typical preschoolers' experiences in both the home and classroom-like settings to determine the effectiveness of the series of four reading and mathematics integrated lessons presented in the form of a four-part, symbiotic intervention. Each integrated lesson included reading and discussing mathematics storybooks, using mathematics manipulatives, and facilitating the use of mathematics vocabulary in conversations; and it was conducted in homes and classrooms in order to determine the effects of the developed symbiotic interventions.

The first research study was a meta-synthesis that was conducted to determine what initial factors affect a child's ability to communicate and then determine what previous studies had identified effects of reading and mathematics integration to be used when considering a child's ability to think and communicate mathematically. A search for relevant literature was conducted using multiple databases including EBSCO, JSTOR, and LibCat in order to find appropriate and timely data to include in the study.

The outcome from this meta-synthesis was the discovery of two major themes: early childhood development and dialogic reading. These primary themes provide a snapshot of the effects of reading and mathematics integration with preschoolers and serve as a justification and framework for the dissertation.

The second research study was conducted using the parents of one- to five- year old children who were enrolled in a private daycare center in a southwestern suburban area. Parents, along with their children, attended four instructional intervention workshops where they were instructed on how to effectively implement symbiotic reading and mathematics experiences (i. e. mathematics storybook readings) into their home environment. Parents reported back on their perception of the effectiveness of the interventions. A tripartite approach was used to collect data on the perceived effects of these interventions including a) surveys and questionnaires, b) informal interviews, and c) researcher observational rubrics and notes.

For the third research study, the same intervention was applied in two different classroom-like settings for preschoolers: one urban, one suburban. The preschool teacher volunteers in both locations were instructed on how to implement symbiotic reading and mathematics interventions through the use of storybooks and early mathematics activities. The effects of this intervention were reported through: a) questionnaires and surveys the teachers completed after instruction and b) informal interviews conducted by the researchers four weeks after the professional development workshop.

These three research studies serve as further evidence to support the theory that symbiotic interventions that include fostering early reading skills while introducing and

applying foundational mathematics vocabulary could benefit preschool students in a long term, tangible way. Through utilizing symbiotic reading and mathematics teaching practices with preschoolers, researchers, parents, teachers, and community stake holders could expect to see these same preschoolers enter elementary schools with a toolbox of refined mathematical understanding because of their early exposure to mathematics vocabulary that could lead to high levels of academic achievement in the future.

Literature Review

Today preschools have become abundant in U. S. communities with most children who are enrolled in out-of-home care facilities attending private daycare centers (Laughlin, 2013) while their parent(s) are at work; thus, the word preschool will be used throughout this dissertation to describe private daycare centers. The general public of the U. S. in all regions wants to support children through their experiences in preschools because a child's enrollment in preschool means that, typically, parents are unavailable to provide care for a certain period of time (Casper & Bianchi, 2002; Kamerman & Gatenio-Gabel, 2007) usually due to work schedules. While it is understood that a child's relationship with his/her parents provides a foundation for their future academic experience (Brooks-Gunn, Han, & Waldfogel, 2010; Palmer & Baroody, 2011), helping influence families to facilitate positive learning environments is more difficult to regulate than defining a central curriculum in preschools.

Establishing a quality preschool experience for all has become the charge of our nation. In his state of the union address, President Barack Obama (2013) mentioned the need for all preschoolers to have access to good preschools because studies have shown

that children who have attended quality preschools were more likely to read and do mathematics on grade level in later grades than those who were not enrolled in quality preschools (Gormley, & Gayer, 2005; Wong, Cook, Barnett, & Jung, 2008). Furthermore, the after effects of the implementation of the No Child Left Behind Act (2002) has led to an overall increase in interest in early childhood classroom curriculums with regards to what is being done to prepare children for formal education while in that setting.

This concern for fostering reading and mathematics development in the most effective way possible with preschool-aged children is at the crux of this dissertation. Studies herein provide evidence that symbiotic reading and mathematics instructional interventions can be conducted in either the home or the preschool classroom that could enhance children's interest in reading and mathematics in today's preschoolers. The implementation of this intervention could ultimately lead to an invigorated love of learning through enhancing early reading, communication, and mathematics vocabulary development.

Research Questions

This dissertation will be investigating the effects of applying symbiotic early reading and foundational mathematics instruction to preschool-aged children. In order to gather sufficient evidence to support the use of a synthesized preschool curriculum, three major research questions have been developed.

1. What effect does symbiotic reading and mathematics integration have on a young child's ability to think and communicate mathematically?

2. How did parents perceive the impact of the symbiotic interventions to affect their child's understanding of mathematics vocabulary and acquisition?
3. How did preschool teachers perceive the incorporation of mathematics storybooks effecting their preschool students' mathematics vocabulary and early mathematics understanding?

Method

The methodological approach of the three research studies of this dissertation varied according to the research question(s) for each study and type of data collected. These studies load heavily on qualitative research components. The first study was a meta-synthesis while the remaining research studies utilized primarily qualitative components to gather and interpret data. The second study specifically studied the effect of a reading and mathematics storybook intervention on the child's early mathematics vocabulary and skill acquisition through creating a pro-reading and pro-mathematics environment in the home. The third study applied the same intervention used in the second study to two different preschool classroom settings in order to determine if teachers in those different locations perceived the intervention as having a positive effect on student mathematics vocabulary and early mathematics understandings.

CHAPTER II

PRESCHOOL INTEGRATED INSTRUCTION

Reading and mathematics consistently form the foundation of educational curricula in the United States. Still, students in the United States underperform students in other industrialized nations in the areas of reading and mathematics according to the scores on the Programme for International Student Assessment (Organization for Economic Co-Operation and Development [OECD], 2004, 2013). Meanwhile, recent research from both educational and psychological perspectives has suggested that developmental milestones in reading and mathematics can be symbiotic (Sarama, Lange, Clements, & Wolfe, 2012). One possible explanation for this connectivity is that students' understanding of mathematics concepts are bound to their mastering of content vocabularies that are used to define, represent and communicate mathematical concepts (Piccolo et al., 2008). It is feasible that improving children's application of mathematics vocabulary would yield a positive effect on their mathematics achievement.

Mathematics is a language for communication and a tool for new discovery (Adams, 2003; Capraro, Capraro, & Rupley, 2011). Learning the vocabulary needed to express oneself effectively is essential for success in today's competitive world economy (Canale & Swain, 1980); this is especially true when considering mathematics learning. Mathematics communication takes place every day in some capacity nationwide in middle and high school classrooms where students are expected to know and be able to apply specialized mathematics vocabulary. That is, students must be able to comprehend what mathematics vocabulary means and apply those specialized, mathematic concepts

when appropriate (Connor & Craig, 2006). However, high school and middle school mathematics coursework is rich in a highly specialized vocabulary that many students are not often exposed to outside of the mathematics classroom. If students are not proficient in utilizing mathematical language to express understanding of mathematics concepts they will be ill-equipped to formulate responses or explain thought processes for problem solving. Furthermore, students with inadequate mathematics vocabulary knowledge can also find themselves lost in the dense vocabulary introduced as part of mathematics learning. Students who lack mathematics communicative competence can also experience a loss of overall mathematics potential.

Just as vocabulary development is essential for developing early reading skills, mathematics vocabulary development is essential to build a foundation for later mathematics conceptual understanding (Bryant, Ugel, Thompson, & Hamff, 1999; Capraro & Joffrion, 2006; Cirillo, Richardson, Bruna, & Herbal-Eisenmann, 2010; Muth, 1982; Piccolo et al., 2008; Samuels & Flor, 1997). These two vocabularies are inextricably interwoven in that the earlier a child can be exposed to mathematical vocabulary words representing concepts, the earlier that child could become proficient in the language of mathematics prior to formal instruction (DeTemple & Snow, 2003; Krashen, 1993). Because children "acquire vocabulary most rapidly and effectively through extensive reading" (Freeman, & Freeman, 2004, p. 209), one way to nurture the development of mathematics vocabulary in young children is through reading mathematics-themed storybooks.

By reading mathematics-themed storybooks during shared reading time, children can begin to understand and use math vocabulary, even at a young age. Participation at an early age in shared reading encourages behaviors such as mutual questioning, responding, and making stories relevant to the child's life that promotes increased reading engagement (DeBruin-Parecki, 1999, 2009; Isbell, Sobol, Lindauer, & Lowrance, 2004). So, if children are exposed to and engaged in mathematics storybook readings, then those children would become proficient in the language of mathematics before beginning formalized schooling (De Temple & Snow, 2003; Krashen, 1993).

Hearing mathematics vocabulary associated with represented concepts during a shared storybook reading can lay a foundation for mathematical understanding that promotes a child's future academic achievement in mathematics. Because children must make sense of mathematical vocabulary in order to communicate and think mathematically (Bryant et al., 1999; Samuels & Flor, 1997) introducing math words to young children can start the thought process of mathematical sense making. Research has shown that in order to reach the necessary level of abstract thinking in mathematics, students must start at the concrete level and gradually move through the representational level (Miller & Mercer, 1997; 1993). The concrete experience of hearing stories during shared reading becomes representational when children learn to read and apply mathematics vocabulary later in their classrooms at school. Some examples of the kinds of mathematics vocabulary that could be used around children when reading mathematics storybooks are found in Appendix A.

Dialogue is another important element of vocabulary acquisition (Sénéchal & Cornell, 1993). It follows then that mathematics dialogue is another dimension of developing a working vocabulary. After all, there exists a co-dependent relationship between general communication language skills and mathematical language skills (Capraro, Capraro, & Rupley, 2010). That is, in order to gauge a child's understanding of mathematics vocabulary, one must encourage a child to talk about mathematics and then respond in kind creating a reciprocal mathematics dialogue.

One way to achieve a reciprocal dialogue is to engage in a shared storybook reading. During shared storybook reading, a storybook is read by an "other" (parent, guardian, teacher) who also facilitates reciprocal conversation with the child as the storybook is being read (Block, & Mangieri, 2002; Wiseman, 2011). Practicing reciprocal conversation patterns during shared storybook reading, the child is able to practice good listening skills, good thinking skills, and good speaking skills to communicate about what they understand from the story (Bradley & Donovan, 2012; Buckley, 1995; Butler & Stevens, 1997; DeBruin-Parecki, 2009; Oczkus, 2010). Through engaging in conversations during shared readings, children are able to build confidence in their ability to process mathematical concepts (such as sorting, charting, and graphing) while nurturing inter-personal relationships (McTigue, Washburn, & Liew, 2009). Talking about stories helps enhance not only mathematical understanding, but also cultivates relationships by facilitating communication between a child and the facilitating adult "other". Children are also able to use these conversations to help make sense of the world around them (DeCaro & Rittle-Johnson, 2012) through processing

and utilizing new vocabulary (Landry, Smith, Swank, Zucker, Crawford, & Solari, 2012; Wiseman, 2011). Previous studies have highlighted the need for preschool students to engage in constructive dialogue with adult "others" and their peers in order to practice sense making, a skill that may help specifically with mathematics meta-cognitive development (Alexander, 2000; Mercer & Sams, 2006). By using mathematics storybooks during a shared interactive reading time, a powerful braiding of advantageous learning experiences can happen with children practicing both computational and reading skills (Muth, 1982) as well as communication and problem solving skills.

The guided dialogues facilitated by adult "others" reading can help children practice mathematics communication skills that could potentially further their academic achievement in mathematics in later years. Reciprocal dialogue with the adult "other" is not the only element of a child's shared storybook experience, sometimes other children are present during shared storybook readings. Having peers present while reading and talking about mathematics storybooks can be advantageous because children are able to not only participate as active readers; they can also use dialogue with each other to understand mathematical vocabulary being addressed in the story (Capraro et al., 2011). By providing children with guidance and practice on how to use language for reasoning and encouraging storybook talks with peers, children can learn to use language more effectively as a tool for solving problems or discussing new concepts or vocabulary (Graue, Clements, Reynolds, & Niles, 2004; Strom, Kemeny, Lehrer, & Forman, 2001). Through participating in interactive dialogues while reading math storybooks, children

are able to get feedback from adult "others" providing a way for children to feel their beliefs or understandings are validated, or to correct misconceptions as they occur (Mason & Bruning, 2001). However, it is imperative that adult "others" provide feedback in such a way that provides encouragement, understanding and acceptance in order for the child to continue participation in the dialogue (Johnston, 2005). If the "other" is consistent in following the pattern of listening to the child's responses to the text and then providing feedback and encouragement, it is more likely that the child will associate positive memories with reading. These positive experiences with reading cultivate a positive attitude toward reading (DeBruin-Parecki, 2009; Isbell et al., 2004; Lundberg, 2009; Polderman, Huizink, Verhulst, Van Beijsterveldt, Boomsma, & Bartels, 2011; Walberg & Tsai, 1985; Westerlund & Lagerberg, 2008) and provide children with a "safe" place to learn new things through stories, including mathematics vocabulary.

When children participate in a dialogue with peers they are practicing the skills needed to solve problems and the communication skills needed to work as a team (Adams, 2003; Alexander, 2000; Garrison & Mora, 1999; Graue et al., 2004; Johnston, 2005; Mercer & Sams, 2006; Strom et al., 2001). These listening, processing and communication skills will be especially valuable when those children matriculate into middle and high school classrooms and are expected to communicate effectively in groups in order to solve problems (Mercer, 1995; Strom et al., 2001). Allowing children to use dialogue to "talk out" their understandings during shared readings is another strong component of advancing early mathematics vocabulary development and fosters effective inner personal communication.

Purpose

Integrated reading and mathematics instruction has been increasingly encouraged as a means of developing problem solving, reading, and mathematics skills (NAEYC & NCTM, 2002). Still, actively promoting mathematical communication is a relatively new phenomenon. The purpose of this study is to determine what previous studies have already found to be the factors that contribute to a child's initial communication development and previously identified effects of reading mathematics storybooks to toddlers or preschoolers. The heart of this study is a focus on the communication development that occurs in young children in tandem with the shared experiences of adults with whom they have significant relationships such as parents or caregivers. Research question one addresses a child's overall communication development with regards to those significant relationships. Investigating communication development as a result of relationships between children and others is a first step in research. This phenomena of interest is whether or not reading and mathematics integration can have an effect on a child's development, which would become irrelevant if one did not first understand how and why the child began communicating initially. In other words, research must first address the process of that communication development in order to justify extending that pattern of development into both early reading and early mathematics. Therefore, this meta-synthesis will focus on these research questions:

1. What factors contribute to a young child's ability to communicate?
2. What effect does reading and mathematics integration have on the young child's ability to think and communicate mathematically?

Methodology

The most clear definition of a meta-synthesis is the systematic gathering, synthesizing and interpreting of previous qualitative research studies (Erwin, Brotherson, & Summers, 2011; Sandelowski, Barroso, & Voils, 2007; Zimmer, 2006). Some researchers have described the process of meta-synthesis as ambiguous and unstructured (Paterson, Dubouloz, Chevrier, Ashe, King, & Moldoveanu, 2009) because meta-synthesis is a relatively new way to gather and interpret data from previously existing research. There has yet to be a universally accepted process established for conducting meta-synthesis. Thus, researchers urge open-mindedness (Walsh & Downe, 2005) toward those conducting meta-synthesis as there is not yet an accepted standard for this form of data analysis. Other perspectives support flexibility within meta-synthesis because there are no hard and fast methods for determining the "correct" way to conduct a meta-synthesis (Paterson et al., 2009; Sandelowski & Barroso, 2003; Walsh & Downe, 2005). However, some researchers prefer to have an established methodology in place for conducting meta-synthesis; one similar to meta-analysis although the purpose of meta-synthesis is to aggregate and interpret previous non-quantitative research findings (Walsh & Downe, 2005; Zimmer, 2006). The steps of meta-analysis involve the researcher forming a question, distinguishing selection criteria (e. g., specific words, phrases, methods), and then beginning a hearty search for relevant literature (Waxman, 2010) from which effect sizes are obtained. Most researchers adhere to this process when conducting a meta-synthesis although the methodology has yet to be solidly

defined throughout the academy (Erwin et al., 2011 Sandelowski & Barroso, 2007; Zimmer, 2006).

When conducting a meta-analysis the researcher utilizes distinguishing elements to filter previous quantitative studies while meta-synthesis relies on the researcher applying systematic judgment to make such a distinction regarding qualitative and mixed methods studies (Sandelowski & Barroso, 2003; Sandelowski et al., 2007). One suggested way to consistently determine which articles to include in a meta-synthesis is to design an ***appraisal tool*** to aid in the filtering of studies (Erwin et al., 2011; Paterson et al., 2009; Sandelowski & Barroso, 2003). The purpose of establishing and using an appraisal tool is to *maintain consistency* and to *justify reasons* for inclusion and exclusion of studies. The appraisal tool should include key words that were used to conduct the meta-synthesis as well as a definitive bookend system that specifies the years that were used to refine relevant literature (Waxman, 2010). Using a bookend system can provide reasonable assurance that the researcher has identified the most up-to-date studies of the phenomena while also providing a sensible time period of background as well. Good bookend systems allow the researcher a window with which to look forward and backward into the literature about a phenomena in a logical way.

Once the researcher has set a parameter with which to gather data, he or she must identify relevant literature utilizing the appraisal tool that has been developed for the meta-synthesis in order to include what is important to the research and discard studies or other artifacts that may be irrelevant. After using the appraisal tool to filter articles to determine what to include in the meta-synthesis, one must begin reading and analyzing

relevant literature in order to determine how the remaining studies are related. Previous researchers have advised others to use caution throughout this step of meta-synthesis so that the integrity of the context of the literature is maintained (Walsh & Downe, 2005). This process of reading and analyzing for thematic congruencies continues until all the literature has been reviewed and common themes have been identified. Once this processes has ended, the researcher then carefully examines what previous researchers have already determined in order to expand the overall understanding of a subject or phenomena (Capraro, 2012; Walsh & Downe, 2005; Waxman, 2010).

The first step in conducting this meta-synthesis involved establishing research parameters including identifying the most appropriate years to bookend relevant literature for this meta-synthesis. A recent special report, *School Involvement in Early Childhood*, was released by the U.S. Department of Education (Hinkle, 2000), paving the way for important changes in the way that early childhood education was viewed in the U. S. This report highlighted a sharp increase of children attending full day kindergarten over the previous decade (Hinkle, 2000). To compensate for increasing kindergarten enrollment numbers and to justify the augmented need for funding in early childhood programs, early childhood curriculums were addressed in the No Child Left Behind (NCLB) Act (2002). NCLB was drafted after the release of this report, later in 2000 with overwhelming support from the U.S. population in response to *School Involvement in Early Childhood* (Hinkle, 2000) and other similar studies. Because 2000 has been identified as a crucial milestone in educational policy, research, and practice, in the areas of both reading and early childhood instruction, the scope of this meta-

synthesis includes literature from 2000 until 2014. Because this study was conducted in the fall of 2014, using that year as a bookend for the study was determined to be the most appropriate bookend year to gather the most complete review of related research that had been published by that point.

Relevant literature was identified using EBSCO, JSTOR, and LibCat databases to locate previous research. EBSCO is an information service that is a leading provider of research databases, e-journals, magazine subscriptions, ebooks and discovery service for the academic, medical, and research communities. JSTOR stands for Journal Storage and is another leading information service provider primarily for researchers in a variety of academic fields. LibCat is an internal search engine at Texas A&M University that stands for "library catalogue".

A leading article that involved the positive effects of dialogic reading with children was previously identified in an earlier meta-synthesis (Arnold, 2005). This leading article was the inspiration for the current meta-synthesis because of the many positive benefits of dialogic reading as well as the practical and relevant advice given for how to use dialogic reading with children. Relevant literature for the current meta-synthesis was identified based on the search phrases specific to that leading article (toddlers, dialogs (language)); picture books; language acquisition; reading aloud to others; parent child relationship; reading motivation; mathematics) using the years 2000-2014. The search resulted in 459 artifacts on EBSCO, 102 artifacts on JSTOR and 18 on LibCat equaling a total 579 related artifacts. These 579 artifacts included books, journal articles, dissertations, policy papers, reports, conference proceedings, and assorted

reference materials including bibliographies and handbooks. A list of all artifacts was printed in order to compare them to identify any duplicate artifacts. Three duplicates were found in the three lists that included all artifacts. Those duplicates included the guiding article (Arnold, 2005), and two others (Doyle & Bramwell, 2006; Jaffe, Beebe, Feldstein, Crown, Jasnow, Rochat, & Stern, 2001), no other articles were repeated; at this point there were 576 total, unique artifacts included at the meta-synthesis.

Then an appraisal tool was developed in order to provide a static justification for inclusion in the study. This appraisal tool was created based on thematic associations with the research questions that this study was attempting to answer. The appraisal tool included refined search key terms in order to create a more precise method for inclusion or elimination. According to this appraisal tool, each artifact had to contain either the word "toddlers" or the word "preschoolers" and one of the following terms: discourse, language, relationships, development in reading or development in mathematics in order to be included in this meta-synthesis.

The title and abstract of each artifact was read and coded according to the appraisal tool that provided the filtering criteria. That is, each artifact had to have either the word "toddlers" or the word "preschoolers" and one of the following terms: discourse, language, relationships, development in reading or development in mathematics. This filtering method created a justification for a coding of "yes", "maybe", or "no" for each artifact. According to these criteria, 19 artifacts were coded "yes" and 18 artifacts were coded "maybe". The artifacts coded "maybe" alluded to the terms found in the appraisal tool but it was unclear if inclusion in the meta-synthesis

would be appropriate. Some artifacts were coded "no" and then eliminated from the meta-synthesis because they centered on another area of study. For example, studies involving deaf education, bilingual education, regionally specific research outside the United States and research on elementary-aged students were no longer considered for inclusion in this study as their content was outside the parameters of this meta-synthesis. For more information on examples of artifacts eliminated in round one, refer to Appendix B. At this point, 37 of the original 579 artifacts were coded either "yes" or "maybe" and thus considered for further review.

Complete copies of these 37 "yes" and "maybe" artifacts were obtained for further analysis to verify inclusion in the study with particular attention paid to the 18 artifacts coded "maybe". These 18 article titles and brief abstracts alluded to two of the criteria on the appraisal tool though it was unclear whether or not they would be appropriate for inclusion in the study. After accessing complete copies of the aforementioned "maybe" coded artifacts and reading those in their entirety, a second round coding and elimination process began. Some examples of themes in the "maybe" artifacts that were recoded "no" during round two are located in Appendix B and include international studies on using storybooks as instructional tools in international studies. Six articles that were coded "maybe" were re-coded "yes" as they included three or more of the criteria on the appraisal tool (Brooks-Gunn et al., 2010; Browne, 2007; Callaghan, Moll, Rokoczy, Warneken, Liszkowski, Behne, Tomasello, & Collins, 2011; Holmes, 2011; Palmer & Baroody, 2011; Stern, 2001). After reviewing all "yes" and "maybe" coded articles, 25 of the original 576 unique artifacts were coded "yes" and included in

this meta-synthesis. A flow chart illustrating the evaluation and elimination process used in this meta-synthesis is found in Figure 1.

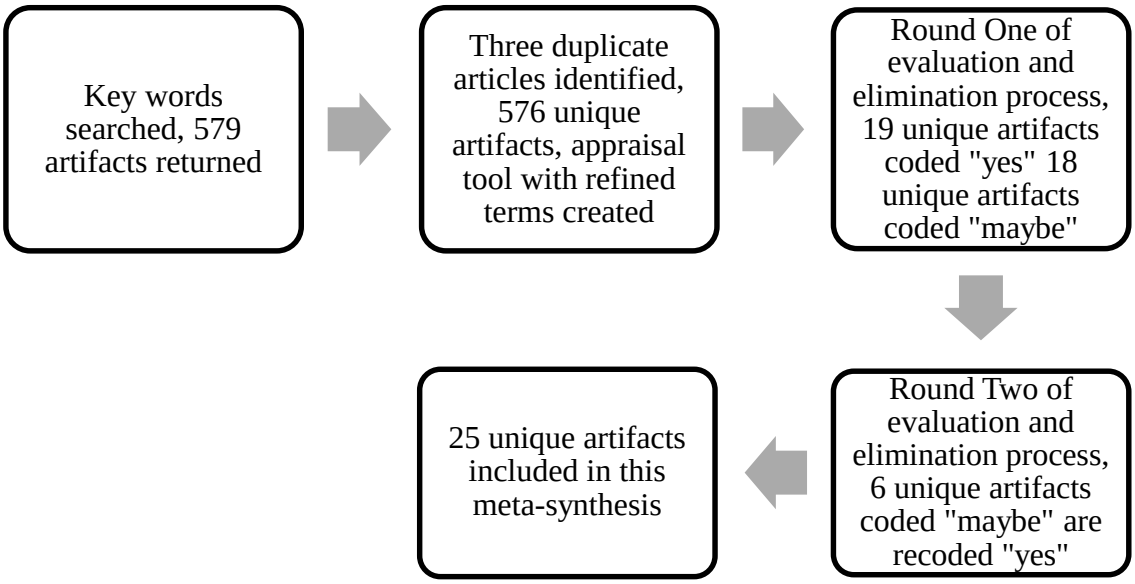

Figure 1. Order of evaluation and elimination process.

Each of the remaining 25 artifacts was re-read in its entirety and again appraised individually according to the appraisal tool to ensure that those marked for inclusion were suitable for the purposes of this study. After this third evaluation of included artifacts, each artifact was summarized in one sentence or less according to thematic resonance found therein. This summary served as a sorting system that provided a medium with which to organize and synthesize artifacts. The majority of the 25 artifacts contained information about communication patterns in children with only seven of the 25 focusing on how to facilitate the communication development of children through

social interactions (such as reading or talking) that occur with significant adults such as parents or caregivers. One major theme found in the literature was the factors affecting early childhood communication development. Some artifacts addressed communication development occurring as a bi-product of social interactions with significant adults such as parents or caregivers. Those social interactions can sometimes contribute to basic socio-cognitive development. Furthermore, bioecological factors such as social interactions that occur in the home and daycare or preschool also have an impact on a child's communication development. Finally, the literature addressed positive effects that reading and mathematics integration can have on a child's linguistic development.

Findings

Factors Contributing to a Child's Ability to Communicate

The most predominant theme found in this meta-synthesis was that of factors that contribute to early childhood communication development. Most artifacts contained data supporting the claim that communication development occurs as a result of shared social interactions with significant adults such as parents or caregivers. Within that overarching theme, two subcategories were identified: *socio-cognitive behaviors that develop in infants and children as a result of social interactions* and *bioecological factors that contribute to linguistic and emergent literacy development of infants and children*.

Socio-cognitive Behavioral Development

There is an increasing interest in understanding the reasons for and the processes contributing to infant and child socio-cognitive development. Socio-cognitive behaviors are identified as interdependent and interwoven cognitive behaviors (e.g. thinking,

reasoning) that one practices in the context of socializing (e.g. communicating with others, searching for intimacy) (Rochat, 2001). Emerging research claims that infants attempt to "reach out" and express themselves through physical and sometimes behavioral communication methods beginning at a very early age in order to establish relationships and share information (Browne, 2007; Holmes, 2011; Rochat, 2001; Stern, 2001). It has been suggested that even as early as four months old infants begin mimicking their mothers' voice patterns in an attempt to communicate (Stern, 2001; Trautman & Rollins, 2006). Communication as a means of becoming associated with one another is a developing process that begins in infancy and becomes more refined throughout childhood.

Researchers interested in studying socialization patterns in children have also started to emphasize the importance of "talk". Barrow (2010) suggested that talk as a form of communication helps children better understand the world around them because they can ask questions and ask for clarification. This is because what children say "offers a window into their thinking" (Brock & Rankin, 2008, p. 5). Researchers have even provided suggestions to parents, teachers and stakeholders to actively teach children to think through problems by "talking them out" in conversation (Siraj-Blatchford, Sylva, Muttock, Gilden, & Bell, 2002). Other researchers study the inverse, instead of investigating communication patterns that children use when guided by adults, they study the way children try to solve problems aloud with no help from an adult to aid with their articulation (Zelazo, Muller, Frye, & Marcovitch, 2003). Although these studies provide foundational work on the development of communication patterns in children,

we are still only beginning to understand the interaction of socialization and communication "talk" patterns and the contribution to organized learning for toddlers and young children (Fernyhough, 2008).

Bioecological Factors Affecting Development

Experiences in the life of a young child lead them to develop more refined communication skills in order to express to those situated in the systems that exist around them. These experiences occur within the framework of two primary bioecological systems: the home and the child care facility (Doyle & Bramwell, 2006; Rodriguez & Tamis-LeMonda, 2011; Rowe, 2008; Weigel et al., 2005). Bioecological systems are defined by Bronfenbrenner (1994) as being "the systems that support and guide human growth" (p. 37). These systems consist of important relationships that exist between a child and their school, family, culture, economy, customs, and bodies of knowledge.

Not only are relationships significant in shaping the bioecological system that a child is situated in, but there are also important experiences that occur within those systems that contribute to a child's development. For example, home experiences encompass everything that happens to and with a child in the home including the relationships children have with their mothers (Brooks-Gunn et al., 2010; Palmer & Baroody, 2011). Additionally, the kind of television programs that children watch (Moses, 2009) contribute to the linguistic development of a child. Even reading has been found to be linked to cultural practices in recent research (Callaghan et al., 2011). Likewise, the experiences that children have in preschool also contribute to their

emerging language and cognitive competencies (Rodriguez & Tamis-LeMonda, 2011). Studying the effect that bioecological systems of the home and child care facility helps further the understanding we have of children's communication and literacy development (Kamil, Pearson, Moje, & Afflerbach, 2010; Pearson, Barr, Kamil, & Mosenthal, 1984; Rowe, 2008; Weigel, Martin, & Bennett 2005).

Reading to and with young children is one experience within both the bioecological system of the home and the school that contributes to literacy development. But only a select population is aware that "how we read to children is every bit as important as how often we read to them" (Arnold, 2005, p. 31) and few know that "a critical factor in shared book reading is the discourse, or verbal interaction, between adults and children" (Doyle & Bramwell, 2006, p. 555). Recent research has highlighted the importance of adults in the school and home reading and then talking about stories they have read with children (Steinhaus, 2000) as a medium to facilitate vocabulary development. This conversational practice can have an impact not only on a child's understanding of a story, but also on the overall communication and literacy development of a child.

Dialogic Reading

One suggested way of promoting communication through dialogue during storybook readings is through the research-supported practice of dialogic reading. Dialogic reading was first introduced by Whitehurst and colleagues in the 1980s (Whitehurst, Falco, Lonigan, Fischel, DeBaryshe, Valdez-Menchaca, & Caulfield, 1988) as a way to optimize reading time to include concurrent literacy and language

development. Recently, dialogic reading has begun to gain interest by researchers in the academy and policy makers (Arnold, 2005; Blom-Hoffman, O'Neil-Pirozzi, Volpe, Cutting, & Bissinger, 2008; Doyle & Bramwell, 2006; U.S Department of Education, Institute of Education Sciences [IES], 2007). One critical factor in dialogic reading is the facilitating of storybook readings by an adult that the child trusts and feels that they can share the reading experience with in a way that allows for their free expression without fear of criticism. Doyle and Bramwell (2006) reported that as a result of dialogic readings "children associated readings with social interactions with other children and with their relationship with (their teacher)" and further, "in the context of secure and dependable teacher-student relationships that young children's overall development thrives" (p. 554). This is an interesting observation on part of those researchers as earlier in this meta-synthesis socialization patterns were discussed as a means of facilitating communication development. In this instance it appears as though socialization through storybook reading causes two effects: one is the development of a positive relationship and the next is the child's desire to express understanding of what is read in the story.

Dialogic reading promotes adults to practice repeated storybook readings with children, starting with an initial reading that allows the child to become acquainted with the text then flowing into a "prompting, evaluating, expanding, and repeating" adult initiated conversation. This is also referred to as the PEER technique (IES, 2007) for prompting dialogue because "the main goal of dialogic reading is for the child to become the storyteller and the adult to facilitate" (Blom-Hoffman et al., 2008, p. 118). After all, "story telling is a powerful context for the development of spoken word" (Brock &

Rankin, 2008, p. 68) and part of the culture that children experience in their everyday life is hearing stories from significant others such as parents, friends, and teachers. Empowering children to become the storyteller allows them to use their unique style to express understanding (Hughes, 2002) while encouraging language and literacy development.

It is feasible that practicing this form of storybook reading could also facilitate cross-curricular instruction, particularly in the area of mathematics. A recent study (Anderson, Anderson, & Shapiro, 2004) attempted to determine whether or not reading mathematical storybooks using the dialogic reading method created a place for mathematical discourse to occur. In other words, Anderson and colleagues (2004) were attempting to determine the effects of reading and mathematics interventions on a child's ability to think and express mathematically. Although a limited number of participants prevented Anderson and colleagues from forming any definitive conclusions regarding the effects of using reading and mathematics interventions on children's early understandings of math concepts, the study provides a foundational piece for future research into the effects of reading and mathematics interventions that use mathematics storybooks (Anderson et al., 2004).

Limitations

Although the information found in this meta-synthesis does provide a wealth of information regarding the effect that relationships have on a child's communication development, it is notable that there is a noticeable gap in information provided about what effect reading and mathematics integration can have on a child's ability to think

and communicate mathematically. One overwhelming issue that came out of conducting this meta-synthesis was that studies on the enhancement of early mathematics development through reading and mathematics interventions have been conducted in international settings (Anderson et al., 2005; Mol, Bus, Jong, & Smeets, 2008). However, studies that were conducted internationally were intentionally excluded from this meta-synthesis because of the complexities of comparing data from a study conducted outside the U.S. to those conducted domestically.

It is feasible that there is more information available on the effect that reading and mathematics interventions have on a child's ability to think and communicate mathematically because it is possible that through the process of finding relevant literature by determining "key words" for inclusion, relevant artifacts could have been excluded. More importantly, although it is plausible that relevant literature was excluded from the current study, it is notable that out of 579 original artifacts, only one actually addressed the effects that reading and mathematics may have on a child's ability to think and communicate mathematically with regards to research conducted with children in the United States. That alone points to a need for further study into the effects of dialogic reading through the lens of creating a foundational mathematics understanding in young children. Still, there is a strong argument to be made for the validity of the findings of this meta-synthesis because 22 of the 25 artifacts utilized were from academic journals, three artifacts were books and one was a conference proceeding. One of the books used in this meta-synthesis *Handbook of Reading Research, Volume IV* (Kamil et al., 2010) is well respected for its breadth of information

that it has garnered attention not only by researchers and practitioners, but also is referenced by policy makers in order to make more informed decisions regarding reading instruction in the classroom. There is value in presenting this spectrum of specific studies within a cohesive vein of thought.

Conclusion

Research examined through this meta-synthesis addressed how and why relationships with significant adults such as parents or caregivers can lead to communication development in young children in order to justify researching the development of a child's ability to think and communicate mathematically. The meta-synthesis examined 25 relevant articles from 2000-2014 resulting in the identification of two major themes: early childhood communication development and dialogic reading as a means of prompting a child into using dialogue during storybook readings.

Most of the literature reviewed in this meta-synthesis addressed research question one "What factors contribute to a young child's ability to communicate?" The major theme that was identified as a means of answering this question was early childhood communication development, two subcategories existed within that theme: socio-cognitive development and bioecological environments. According to data presented in the literature, children begin to develop socio-cognitively, that is to think and then communicate, in order to express needs, understanding, and association starting at a very young age (Browne, 2007; Holmes, 2011; Rochat, 2001; Stern, 2001; Trautman & Rollins, 2006). This attempt on part of the child to effectively communicate with significant "others" in their environment evolves into a more refined method through the

development of articulation through speaking, or "talk" (Barrow, 2010; Brock & Rankin, 2008; Fernyhough, 2008; Siraj-Blatchford et al., 2002). The study of speech patterns in children is significant to this study because it helps identify ways in which a child will want to begin expressing his or herself, an important consideration to have before delving into a more specific area like facilitating a child's ability to communicate mathematically. It is notable that these researchers all approached a child's communication development through a developmental, educational research lens rather than through a psychological lens. This is interesting because educational researchers tend to agree that a child's early development does have an effect on the child's ability to attain skills and excel later in life and yet there is very little educational research on a child's development very early in life.

Another striking finding from this meta-synthesis with regards to research question one is the role that significant factors play in a child's early communication development. One factor was the bioecological settings that a child exists within during their normal daily life: specifically in the home and preschool (Bronfenbrenner, 1994; Doyle & Bramwell, 2006; Rodriguez & Tamis-LeMonda, 2011; Rowe, 2008; Weigel et al., 2005). Researchers outlined how significant the activities that occur within those settings can be to all facets of a child's development (Arnold, 2005; Brooks-Gunn et al., 2010; Doyle & Bromwell, 2006; Kamil et al., 2010; Moses, 2009; Pearson, et al., 1984; Rodriguez & Tamis-LeMonda, 2011; Rowe, 2008; Weigel, et al., 2005). Because of the emphasis on the bioecological settings of the home and preschool as critical to a child's early communication development, it is necessary to reiterate that future research studies

should focus on these factors not only as unique but also as interdependent in order to determine the best ways to facilitate early communication development.

With regards to research question two, "What effect does reading and mathematics integration have on a child's ability to think and communicate mathematically?" Researchers have only begun to explore the effects that reading and mathematics interventions may have on a child. With regards to thinking and communicating understanding, Doyle and Bramwell (2006) reported that using a dialogic approach to reading can help facilitate a child's vocabulary development. Their study provided evidence that when children are encouraged to express understanding of a story while in a "safe" environment with a trusted adult, there is an increase in the child's overall development because the child wants to express understanding and ultimately wants to learn more. More specifically, according to the foundational study done in the U.S. by Anderson and colleagues (2004), any child experiencing an integration of reading and mathematics that promotes the use of dialogue in a child should lead to positive outcomes for the child regarding their ability to think and communicate mathematically. However, this study was the only of its kind identified in this meta-synthesis providing a notable gap for future research to explore the effects of reading and mathematics integration on young children in the U.S.

It is also important to mention researcher cautions that were found in the literature from this meta-synthesis when considering formulating a future study. For example, despite the fact that reading researchers have usually encouraged strict quantitative methodologies in the past, a new push has emerged to encourage flexibility

in the field of research (Kamil et al., 2010) in order to keep open-minded to new methods of studying phenomena. Researchers also encouraged future home studies as a means of gathering data on children (Rowe, 2008), citing ecological validity (Palmer & Baroody, 2011) as justification to gather the most authentic data possible from the perspective of a caretaker who is then considered to be a researcher. Some studies cautioned against using video or tape recording when doing studies about young children (Blom-Hoffman et al., 2008; Holmes, 2011; Stern, 2001; Trautman & Rollins, 2006) discussing how those kinds of recording equipment sometimes got in the way of gathering authentic data. These suggestions for further research provide a solid guideline for future studies to follow appropriately in order to extend what data have been gathered here.

The results of this meta-synthesis emphasize that further research is needed. Careful consideration should be placed on the methods in which studies are constructed going forward that maintain the integrity of collected data. By studying family dyads and the effects of this or any phenomena on children in their most safe and secure environment, future research can better understand and explain the ways in which children develop communication skills, particularly when those skills are fostered through reading and mathematics interventions.

CHAPTER III

COUPLING READING AND MATH:

CREATING A FAMILY ENVIRONMENT FOR LEARNING

A small, but rapidly growing body of research supports that fundamental mathematic and reading concepts acquired during children's preschool years provide a foundation of basic thinking skills that could increase their likelihood of learning success when they enter a formal school setting. The International Reading Association (IRA) and the National Association for the Education of Young Children (IRA & NAEYC, 1998) jointly stated that the single most important activity for building skills essential for reading success with preschoolers is reading aloud to them. Regularly reading aloud with young children makes reading and its concepts accessible to them at an early age (Ehri, Nunes, Willows, Schuster, Yaghoub-Zadeh, & Shanahan, 2001; Snow, Burns, & Griffin, 1998). Furthermore, children who engage in early informal reading activities (being read to, using invented spelling, telling stories, manipulating books, etc.) over extended periods of time experience an increase in their vocabulary without formal instruction (De Temple & Snow, 2003; Krashen, 1993).

As with reading, children can acquire early mathematical capabilities through parent supported activities (Harper & Pelletier, 2010) such as using storybooks that include the content of mathematics. Reading and mathematical concepts can reciprocally support each other and together enhance children's success in their beginning formal education. Results from studies conducted from both educational and psychological perspectives have proposed that developmental milestones in mathematics and reading

can be symbiotic (Sarama et al., 2012). For example, it is not unusual for a child to recognize a spoken word from sounds in the word and a picture coupled with the word. The same logic can be used regarding early numeracy; a child can hear a spoken word "nine" and begin to recognize the numeral "9", making this connection is an important foundational math skill. Early word recognition and early decoding of mathematics vocabulary and numerals are similar patterns of symbolic recognition. Through acknowledging and understanding simple words and numerals, children also either knowingly or unknowingly recognizing that these words and numerals are symbolic means for representing meaning (Capraro et al., 2010).

Aside from enhancing early decoding and early numeracy skills in mathematics, there is evidence to suggest that enhancing oral language through family shared readings may help deter students from having reading deficits (Bowyer-Crane, Snowling, Duff, Fieldsend, Carroll, Miles, Go¨tz, & Hulme, 2008). Perhaps learning mathematics vocabulary through storybooks can serve a dual purpose that prepares preschoolers for the two most focused on beginning skills in formal schooling—reading and mathematics. Shared interactive storybook readings are a great way for parents to engage their children in learning activities at home. It is reasonable to suggest that by blending reading and mathematics processing through storybooks during family shared reading time a symbiotic braiding of thought processes could occur, helping young children develop intellectual capital that they otherwise could not obtain.

Parents who establish learning environments in homes that challenge their children at or above their learning abilities find that their children also develop self-

regulatory abilities in tandem with their cognitive development (Blair & Razza, 2007). Self-regulation is the ability to "keep going" when encountering setbacks and effortful control is a closely related skill that is associated with the ability to focus on a task, job, or idea. It promotes attention to learning tasks, which enhance students with the opportunity to learn (Rupley & Willson, 1991).

Effortful control and self-regulation are necessary for acquiring good reading and mathematics skills. As noted by McClelland, Morrison, and Holmes (2000) having the ability to sit still and pay attention is strongly associated with later school success independent of cognitive ability. Nurturing good habits of learning with their children, parents are also able to supplement their child's skills in self-regulation and effortful control.

Effortful control can promote self-confidence in children including the ability to overcome self-doubt (Karpinski & Scullin, 2009). Moreover, current studies have also found that there is a strong link between reading and mathematics achievement and effortful control (Geary & Bjorklund, 2000; Lan, Legare, Ponitz, Li, & Morrison, 2011), which includes the ability to self-regulate (Wiebe, Espy, & Charak, 2008). An expanding body of research points to elements of connectedness existing in the meta-cognitive processes used when doing early mathematics and reading (Desoete, Roeyers, & Buysse, 2001; Hines, & Kritsonis, 2008; Panaoura & Philippou, 2007). Consider the fact that many of the same problem solving habits of the mind that help children decode and comprehend written text are also used in a similar but undefined way in mathematics (Capraro et al, 2010). Another current study (Pimperton & Nation, 2010) found that

poor reading comprehenders also have other underlying impairments that can affect performance in both math and vocabulary comprehension. In other words, a deficiency in linguistic processing in many cases could also indicate a congruent learning deficiency in mathematics processing. Based on this assumption it is then rational to infer that strengthening linguistic processing skills can concurrently lead to an increase in mathematics processing skills.

Parent-directed learning interactions in the home provide opportunities that can contribute to a child's long term development (Coleman, 1990; Ren & Hu, 2011) and researchers have called for an increase in investigations that center on the effects of home learning environments on preschoolers learning (Hindman & Morrison, 2011; Niklas & Schneider, 2013). It is within reason to argue that home learning environments facilitate foundational learning (DeBruin-Parecki, 2009; Rothstein, 2004) in a child's expressive vocabulary (Landry et al., 2012), literacy development (Niklas & Schneider, 2013), early mathematic attainment (Loeb, Bridges, Bassok, Fuller, & Rumberger, 2007), and socio-emotional skills development (Rodriguez, Hines, & Montiel, 2009; Zellman & Waterman, 1998). Families that nurture their children's learning in the home are helping the child form a positive attitude about learning and an interest in discovery; that will aide in later academic achievement (Hindman & Morrison, 2011).

Positive parent-child relationships have long been recognized as contributing factors to a child's success in a formal school setting. (McBride, 1990; Reynolds, Mavrogenes, Bezruczko, & Hagemann, 1996; Stahmer & Gist, 2001). These positive relationships have resulted in parents acquiring a deeper and more complete knowledge

of their children's learning capabilities (Fan & Chen, 2001). Such knowledge enable parents to become more aware of changes they can use in the home, including the development of parent initiated positive learning environments (Quiocho, & Daoud, 2006; Ramirez, 2004). Recent research has affirmed the important role that home environment and by proxy, parents, play in development of early skills for preschoolers (Sénéchal & LeFevre, 2014; Skwarchuk, Sowinski & LeFevre, 2014).One way research has begun to acknowledge the role of the parent in the research process is by asking for parent input while doing "home environment" studies. Including parents in the research process helps validate their roles as data providers for research purposes (Leung, Sanders, Leung, Mak, & Lau, 2003; Mann, Pearl, & Behle, 2004; St. Pierre, Ricciuti, & Rimdzius, 2005) in much the same way teachers are used as professional observers (Choppin, 2011; Jacobs, Lamb, Phillipp, Schappelle, & Burke, 2007; Lappan, Fey, Fitzgerald, Friel, & Phillips, 2006). Recognizing and capitalizing on this special relationship that is developed between a parent and child during appropriate and enjoyable in home learning activities can provide engaging learning experiences that with unique modification for each child may carry far into future learning.

Affirmation of the benefits of parent-directed learning activities in the home for young children is reported in findings from a meta-analysis of six long-term studies of school readiness (Duncan, Dowsett, Claessens, Magnuson, Huston, Kleganov, Pagani, Feinstein, Engel, Brooks-Gunn, Sexton, Duckworth, & Japel, 2007).These researchers found that when controlling for cognition, attention, and socio-emotional skills the best predictors of early school success are a child's foundational math skills and reading

skills. In fact, early math skills have been found to be twice a strong predictor of academic success as reading skills (Duncan et al., 2007). Preschoolers with basic math and reading skills outperformed children without the skills with entering a formal education setting (Purpura, Hume, Sims, & Lonigan, 2011). Such evidence supports that young children can be better prepared for success in both reading and mathematics before entering formal schooling because of parent/child in home learning environments.

Purpose

The current inquiry is intended to provide further insights into the symbiosis between enhancing foundational reading and early mathematics skills through creating a pro-reading and pro-mathematics home environment using parent supported interventions. Because past studies on family literacy have alluded to the importance of parent participation in reading at home (Ho, Leung, & Cheung, 2011; Lundberg, 2009; Morrow, 1983; Raikes, Pan, Luze, Tamis-LeMonda, Brooks-Gunn, Constantine, Tarullo, Raikes, & Rodriguez, 2006; Santos, & Alfred, 2011; Walberg & Tsai, 1985; Westerlund & Lagerberg, 2008), this study was developed to further substantiate the importance of reading at home while showing consideration for the development of positive socio-cognitive behaviors. Furthermore, this study was developed because previous research has called for increased studies on the development of effortful control in young children (Willoughby, Kupersmidt, & Voegler-Lee, Bryant, 2011). The combination of parent-supported reading strategies, positive socio-cognitive behaviors and the bioecological setting of the home were previously identified as important dimensions of a child's foundational academic development in Chapter 2 of this dissertation.

This study centers on one specific bioecological setting: the home. Since storybook reading is already a practice in the homes of most young children, mathematics storybooks were used to in this study as a way to integrate early concepts associated with both early numeracy and foundational reading. Storybook reading times focused on parent(s) and child(ren) interacting with storybooks in such way that they come "alive" through enriching dialogues, pretend play, and other forms of sense making that promote critical thinking (Bradley & Donovan, 2012). The hope was that these factors would maximize the potential benefits of reading interaction time between parents and children. In order to guide our inquiry of the symbiotic reading and mathematics environment, we identified several questions:

1. Does parents' use of reading/mathematics story books in home instruction enhance child(ren)'s understanding of early mathematics concepts?
2. Does parents' use of reading/mathematics storybooks in home instruction enhance child(ren)'s basic reading skills (recognition of letters, sight word recognition, letter sound relationships, text features, etc.)?
3. Does parents' use of reading/mathematics storybooks in home instruction aid in the development of child(ren)'s mathematics vocabulary?
4. Does parents)' use of reading/mathematics storybooks in home instruction positively impact child(ren)'s effortful control?

Theoretical Framework

Theoretical framework was based on quilting together several elements of emergent literacy and mathematical theories including the idea that children's literacy

understandings begin early and before formal education (Sulzby, 1985, 1988; Sulzby & Teale, 1987; Valencia & Sulzby, 1991). We also agreed that children learn to use language through engaging in dialogues with a newly acquired language (Harste & Woodward, 1989). Thus, the hope was that the language of mathematics (Adams, 2003; Capraro et al., 2010, 2011) obtained through parent guided interactions (Kinney, 2008) with mathematics storybooks would bind together mathematics and reading into a single experience for the children (Stanberry, 2014). We were speculating that parents' reading mathematics storybooks to children enhanced: (1) understanding of early mathematics concepts, (2) overall foundational reading skills, (3) the utilization of mathematics vocabulary and (4) overall effortful control.

Further theoretical framework for our inquiry is provided by the Pygmalion theory of Rosenthal and Jacobson (1968, 1992). Basically, this theory states when adults form expectations for children's behavior they act in a differential manner based on those expectations (Appendix C). The assumption was that if our exploration of melding mathematics and reading is consistent with this well-known theory, the child's early mathematics conceptual understandings, foundational reading skills, utilization of mathematics vocabulary and display of effortful control would conform more closely to what was expected of the adult counterpart. Through application of the Pygmalion theory we assumed that if a parent believed a child capable of understanding and engaging in mathematical and reading activities and dialogues then a child would exhibit behaviors showing that they were capable of engaging in mathematical dialogues and early mathematics activities. This relationship illustrates the impact of adult

expectations on child's performance in our related outcomes: enhanced knowledge in early mathematics, foundational reading, mathematics vocabulary and effortful control.

Methodology

This study consisted of the parents of children who were enrolled in a private daycare in a large southwestern suburban area. The site was chosen based on its cosmopolitan makeup; four middle class families with children volunteered to participate. Parents' ages ranged from early-30s to mid-40s; the ages of their children varied from one- to five-years-old. Families included one African-American mother with two children, one Asian-American father with two children, and one Anglo-American father with one child and one Anglo-American mother with two children. Thus, there were four parents and seven children. These families learned about the study because fliers were posted throughout the daycare center a week before the first voluntary training session to inform parents about the opportunity to participate in the study. Each flier included an informational overview, dates, time, and onsite location of training sessions.

Because participants had children enrolled in a daycare facility it was understood that parents had time constraints that effected their ability to stay home as a full time care giver. Past studies on family literacy have urged flexibility on part of the researchers with regards to length of training sessions and the time when those sessions are held in order to include fathers (Morgan, Nutbrown, & Hannon, 2009). Therefore each "come and go" training session was held over an approximately one and a half hour period allowing parents to arrive at the onsite training after picking up their child(ren),

participate in an individualized training session, and then go home to ensure engagement on part of both the parent and the child(ren) at the end of their day.

Data were obtained through surveys, observations, and interviews. This tripartite approach is commonly used when attempting to evaluate instructional methods (Cuevas, Lee, Hart, & Deaktor, 2005; Lee, Deaktor, Hart, Cuevas, & Enders, 2005; Lee, & Luykx, 2005; Lee, Luykx, Buxton, & Shaver, 2007; Lee, Maerten-Rivera, Penfield, LeRoy, & Secada, 2008; Lee, Maerten-Rivera, Buxton, Penfield, & Secada, 2009a; Lee, Mahotiere, Salinas, Penfield, & Maerten-Rivera, 2009b). These methods enabled us to synthesize mathematics storybook reading practices and mathematical understandings, early numeracy development, word recognition and oral language development, interest in math activities and effortful control of the child during family shared mathematics storybook reading.

Training Sessions

Curriculum Development

Each weekly training session was designed to provide detailed strategies on how to create a pro-reading and pro-mathematics environment in the home while providing materials for parents to implement them. These proposed strategies facilitated the enhancement of reading through symbiotic mathematics instruction in the home using recommendations by DeBruin-Parecki (1999) and "Hands-on-math strategies: Edible math-Primary" by Kinney (2008). DeBruin-Parecki's research (1999) centered on establishing an effective family early mathematics literacy program with an emphasis on interactive reading based on detailed home activities and materials that organically

integrate mathematics and reading. For example, following a recipe naturally marries reading to mathematics and that is a common practice in the home. The prescribed lessons found in "Hands on math strategies: Edible math-Primary" (Kinney, 2008) focused on synthesizing and presenting other activities for children to do at home using food manipulatives to learn mathematics.

The four-part intervention suggested in this study was developed based on a synthesis of these earlier research based approaches to addressing child early literacy and child early math attainment (DeBruin-Parecki, 1999; Kinney, 2008) while supporting a triangulated method of instruction that has been found to be successful when teaching children (Stanberry, 2014). Each of the four parts of the intervention includes a children's word counting book, corresponding snack, and manipulative activity that help parents to create a pro-reading/pro-mathematics environment in the home.

Still, simply providing materials to families is not enough to develop a reading and mathematics friendly environment in the home, parents must know what to do with those materials. Therefore, a list of suggested pro-reading and pro-mathematics parent behaviors were developed using the joint position statement issued by The National Association of the Education of Young Children and the National Council of Teachers of Mathematics (NAEYC & NCTM, 2002). This statement was adapted into a family based-adult/child curricula for interactive reading time utilizing the developed intervention (see Appendix D). The behavior suggested in the curricula centered around enhancing a child's understanding of early math through reading developmentally

appropriate math storybooks, practicing good reading skills, promoting vocabulary acquisition through answering questions about new mathematics words (see Appendix A for examples), and incorporating new words into family discussions while observing whether or not there was a change in a child's effortful control. Additionally, surveys were adapted to correspond to each part of the intervention in order to gather self-reported data from parents (Appendix E). Respecting parents as keepers of special knowledge about their children puts them in place to be valuable to the research process (Leung et al., 2003; Mann et al., 2004; St. Pierre et al., 2005) and self-reporting has been found to be an effective method of collection with home studies (Palmer & Baroody, 2011). So each part of the intervention focused on applying unique elements of the adapted curricula in order to create a pro-reading and pro-mathematics home environment then the parents reported their perception of the application of that curricula at the next training.

Curriculum Application

Family oriented "come and go" training sessions occurred over the course of four weeks. Each training session was open onsite for approximately 90 minutes and took place during the same specified "after work" hours over four concurrent weeks. Families were individually stepped through the entire training procedure as they arrived at the session over an approximately 15-30 minute period and were then informally dismissed. Parents were welcomed into the first training session with an introduction by the researcher and an explanation of the purpose of the study. Following this introduction, parents completed a pre-intervention survey intended to identify what behaviors their

family already engaged in to promote a pro-reading/mathematics environment in their homes. We used this survey information to establish baseline information on reading/mathematics home instruction prior to any training.

After the initial, introductory session in which the first week's suggested behaviors were presented and modeled, each training session opened with parents completing a survey corresponding to the following week's intervention. Then parents shared observations with the researcher in a conversational, non-structured interview in order to report experiences, concerns, and excitement about trying the previous week's behaviors in their homes. Each parent was first asked the question "How did your child respond to this week's instructional activities?" and then follow-up questions were asked based on parents' responses (Baumbusch, 2010). The researcher used a short hand method to take notes on the informal conversation with each parent in order to maintain an authentic exchange and relationship with each of them. Parents were then presented with a new part of the intervention for the coming week using detailed explanation and modeling. First, the researcher explained the new suggested intervention. Next the researcher modeled the intervention with her 19 month old son while participating parents watched. Subsequently parents practiced these strategies with their own children with the researcher watching and addressing questions and providing clarification to ensure understanding of the newly introduced part of the intervention. Observational data on family behaviors during these practice times was recorded through hand written notes. The observation portion of the training session was important because it was hypothesized that when families practiced new behaviors with supervision and

constructive feedback, they would then use the same kinds of behaviors in their homes. To assure consistency, parents were encouraged to ask questions about the new expectations introduced each week. After questions were answered, parents were given a "goodie bag" that supported the implementation of each intervention. The goodie bag contained (A) the mathematics counting storybook for the week (McGrath, 1994, 2000a, 2000b; McGrath, & McGrath, 1998) for instance the Pepperidge Farm Goldfish Counting Fun book, (B) a snack to compliment the storybook for the week such as Goldfish crackers, (C) a supplemental early math activity such as charting or sorting using the snack provided, and (D) a detailed synopsis of the suggested behaviors presented at the training session, see Appendix D for more information. The components of the "goodie bag" represented the weekly curriculum for creating a reading/mathematics home environment in order to assure fidelity of implementation.

Findings

As anticipated, there were strong positive responses provided by parents about promoting child's learning through employing the learned strategies of mathematics/reading dialogues and activities. Foundational mathematics, foundational reading practices, vocabulary acquisition and effortful control were impacted by the suggested pro-reading/mathematics behaviors. The information presented in the results represents responses from the four families who participated.

Data collected during the interviews revealed that reading/mathematics home instruction behaviors resulted in children developing foundational reading skills including word recognition, enhanced development of oral language skills, through

using mathematics vocabulary, and that mathematics activities helped their child understand mathematics concepts. These results confirm findings reported by Green (1995) and Stone (1990) on the capabilities of parents to instruct their children effectively when provide guidance and support.

Parents overwhelmingly voiced their desire to incorporate math into their family dialogues after being exposed to the home learning strategies. Reponses that confirmed this were, “Being a part of this has opened my eyes.” and “Before this point by my own choice I had selected more verbal and language focused books, and not math focused. This is making me much more aware.” (Question 1, 3) One parent shared that during family shared reading time, they “talked about the vocabulary found in pictures, math storybook reading time wasn’t just about the numbers” (Question 2, 3) this observation was intriguing because it provided evidence of the skill development symbiosis that occurs when using mathematics storybooks as a medium of symbiotic reading and mathematics learning. Another parent mentioned that when she questioned her children about adding and subtracting snacks as an extension to the math activity, she claimed “it was easy for them, addition and subtraction came naturally to them.” (Question 1) The parent understood her child’s developmental capabilities and pushed the child forward to more challenging mathematics concepts than those suggested confirming that a parent has intuitive knowledge of the capabilities of her child and know how to stretch the thought processes while accommodating learning (Blair & Razza, 2007).

All parents reported an increase in mathematically based conversations-and other conversation topics in general as parents became more aware not only of their child’s

propensity to learn mathematics but also of their child's developing vocabulary. In other words, parents stated that they felt as though they were able to talk to their children conversationally rather than using "baby talk" because this activity had opened them to the idea that young children could participate in normal conversations. Thus the training expanded avenues of expression for families to talk to their children, including the enhancement of expressive mathematics vocabulary (Appendix A) while offering the idea to parents that children, too, can practice thought processing and self-expression. (Question 3)

There were serendipitous data obtained through observation of family interactions with new materials during training activities. One particular family consisted of a mother and her two sons-ages two and five years old. Even though the boys were excited about going home and not necessarily participating in a particular training session, their attention was piqued when the math storybooks and corresponding snacks were presented in a goodie bag. Without prompting, the young boys started looking through the storybook provided for the week and they began "play reading" to each other. The older brother started interacting with text, sounding out words to his younger brother and making up words he did not know by using association with pictures in the storybooks. He also directed his brother where to place his snacks in the indicated areas of the storybook. Both boys ate their snacks after reading the storybook and doing corresponding mathematics activity.

These young boys were not prompted to participate in these activities but were praised by their mother for doing so. The boys remained engaged in interacting with the

text in the storybook and mathematics activity independently even as the trainer explained next week's reading/mathematics home instruction to the mother. The mother confirmed that these sorts of behaviors were similar to what the boys would do when driving home from training sessions. She noted how both boys were extremely interested not only in reading but also in learning more and talking more about mathematics as a result of the mathematics storybooks, snacks, and activities. (Question 4)

Limitations

A major issue in this study was participant mortality. Although previous foundational studies on symbiotic reading and mathematics instruction have been conducted using as little as four family dyads (Anderson et al., 2004) we had hoped to include more families in this study. Though eight families attended our training sessions, only four completed the entire intervention series. Still, previous studies have concluded that family training activities must have flexibility in order to have sustained parent participation (Morgan et al., 2009) so we allowed those families that had not been a part of the entire study to attend sessions in an effort to aid those families in creating a pro-reading and pro-mathematics environment in their homes despite their data being incomplete for inclusion in the study. It is also notable that the current study was conducted during the summer, which could have had an adverse effect on continued family participation.

Conclusions

This inquiry advanced the importance of the acquisition of foundational skills in reading and mathematics skill building (Duncan et al., 2007), verified the value of socio-

emotional skill building (McClelland et al., 2000), and supported the call for further evidence of the emergence of effortful control in young learners (Willoughby et al.,2011) through integrated activities in reading and math. Strong corroboration emerged that reinforced the notion that children need to engage in fun, semi-structured educational learning activities in their homes (Blair & Razza, 2007) in order to capitalize on their curiosity about the world. The positive reactions and enthusiasm of the parents validate the theoretical framework we utilized (Rosenthal & Jacobson, 1968, 1992; Sulzby, 1985, 1988; Sulzby & Teale, 1987; Valencia & Sulzby, 1991). Information we collected substantiated that children were exhibiting early literacy and mathematics behaviors through their exploration of mathematic storybooks.

Our snapshot of the effects of this reading/mathematics home instruction program presents a picture that has value for preschool parents and educators. For example, there was evidence that future academic achievement could be enhanced for participating children because their parents established a manageable home learning environment. The reading/mathematics home instruction provided children with the opportunity to build on integrated early mathematics skills and foundational reading skills while learning new vocabulary. Home learning activities created opportunities for children to learn and practice socio-emotional skills, such as effortful control when reading and talking about the mathematics storybooks and engaging in related activities. There was also relationship building through enriching family conversations that were attributed to parents' use of instructional activities and confirms earlier research by Landry et al. (2012).

Parents reported overwhelmingly that their children responded favorably to their newly developed pro-reading/mathematics home environments. It could be argued that the children's positive responses were indicative of responding to parents' belief that they could learn and understand mathematics/reading. This inference supports the Pygmalion effect (Rosenthal & Jacobson, 1968, 1992) because parent expectations for their child certainly evolved when new information about mathematics was introduced during reading/mathematics home instruction.

Other influences that emerged during non-structured interviews were related specifically to how the suggested behaviors made learning "fun" and exciting, supporting the benefit of such practices as pointed out in earlier studies (Blair, & Razza, 2007; Stanberry, 2014). All parents acknowledged that their children liked the math storybooks because they incorporated colorful snacks for the children to eat and that children responded well to counting books that had provided cut outs for specific placement of the snack for the week. Observation of each family provided unique and valuable data on the dynamics of family shared reading times. One family's experience directly embodied the theories presented by McClelland et al. (2000) regarding the value of attention skills as well as those indicating that reading and mathematics are both valuable when considering a child's exhibiting effortful control (Duncan et al., 2007). Parents also agreed that their children liked sorting things. These observations reinforce the importance of providing children with engaging, informal learning environments in the home.

CHAPTER IV

PRESCHOOL: USING STORYBOOK INSTRUCTION TO ENHANCE FOUNDATIONAL READING AND MATHEMATICS

Early childhood programs in the U.S. have received increased attention in recent years due to No Child Left Behind Act (2002) and its goal of creating equity for all. Citizens and researchers continue to call for ways to provide effective and meaningful early childhood experiences for all children so that they are equally well prepared for the academic challenges they will face in formal schooling (Barnett, 2010; Boocock, 1995; Calman & Tarr-Whelan, 2005; Duncan & Magnuson, 2011; Knudsen, Heckman, Cameron, & Shonkoff, 2006; Leonhardt, 2010; New, 1998; Shokonkoff, 2010). Because of the lackluster ranking of the United States in recent international comparative studies, policy makers, stakeholders, and leaders are looking for ways to utilize early childhood experiences as a way to facilitate learning in young children in order to earn higher scores and ultimately to attain a more educated populace in the future.

A proposed method to capitalize on early childhood instructional time is to teach two curriculums symbiotically and concurrently via symbiotic interventions. Research from both educational and psychological perspectives has suggested that developmental milestones in reading and mathematics can be symbiotic (Sarama et al., 2012). One possible explanation for this connectivity is because students' understanding of mathematics concepts are bound to their mastery of content vocabulary that is used to define, represent and communicate the mathematical concepts (Piccolo et al., 2008).

Hence, it is feasible that improving a child's application of mathematics vocabulary would also yield a positive effect on that child's mathematics achievement.

One way to prepare preschool age children for later schooling is to engage them in activities that are reflective of those they will encounter in formal education. Research findings have supported dialogic reading (Arnold, 2005; Blom-Hoffman et al., 2008; Doyle & Bramwell, 2006; IES, 2007; Whitehurst et al., 1988) as a way to empower children to verbalize what they understand from storybook readings through interactive conversations. Through directing storybook centered conversations, adult facilitators are able to pique a child's interest in the story while enabling the child to talk about what they understand and clarify meanings. In other words, "what children say offers a window into their thinking" (Brock & Rankin, 2008, p. 5) and there is evidence that practicing think aloud discussions in concurrence with storybook readings fosters metacognitive development (Siraj-Blatchford et al., 2002). Vocalizing ideas helps children to negotiate meaning and find understanding (Barrow, 2010; Hughes, 2002) and children need to hear adults verbalize internal dialogue (Rowe, 2008).

There is a growing body of international studies on the effects of utilizing mathematics storybooks in tandem with dialogic reading activities as a means to instruct young children in early mathematics learning (Anderson, Anderson, & Shapiro, 2005; Hay & Fielding-Barnsley, 2012; Mol, Bus, deJong, & Smeets, 2008; Rasku-Puttonen, Lerkkanen, Poikkeus, Siekkinen, 2012). Data from these international studies offers increasing evidence about the importance of small group concurrent story and talk time (Brock & Rankin, 2008) on the development of both receptive and expressive

vocabulary in young children, particularly with mathematics vocabulary (Anderson et al., 2005). Furthermore, repeated exposure to math storybooks could lead to early fluency in mathematics language (Anderson et al., 2004, 2005). By using mathematics storybooks as a medium of conversation starting, preschool-aged children could be immersed in mathematical vocabulary and math dialogue helping prepare them for formal mathematics schooling in later years.

Still, few studies have investigated the intertwined effects of storybooks on children's acquisition of reading and mathematics concepts domestically (Anderson et al., 2004). Researchers have warned against assuming the universality of reading treatments (Anderson et al., 2004) and have recently found evidence there is a cultural basis for learning literacy tasks (Callaghan et al., 2011; Rowe, 2008). Thus it is necessary to replicate these kinds of concurrent reading and mathematics instructional studies in the United States. This research needs to be accomplished before broad scale implementation especially considering the potential costs of implementation although those would be offset by potential benefits if they could be found.

Purpose

The purpose of this study is to respond to the call from earlier researchers to explore the effects of reading treatments on diverse early childhood populations (Anderson et al., 2004) while also focusing on the call for home and child-care literacy practices to be more consistent (Weigel et al., 2005). This research will attempt to satisfy both calls by comparing teacher reported results of the implementation of a reading/math intervention on two different populations of preschool-aged children.

The intervention used in this study was developed using a model based on dialogic reading (DeBruin-Parecki, 1999, 2009; Oczkus, 2010; Whitehurst et al.,1988) as a medium of instruction coupled with the action-based learning model suggested by Kinney (2008) in her research based prescribed lessons "Hands on math strategies: Edible math-Primary". This synthesized intervention was designed to help preschool-aged children develop early mathematics vocabulary (Anderson, et al., 2004) through the use of age appropriate mathematics storybooks (McGrath, 1994; McGrath, 2000a; McGrath, 2000b; McGrath, & McGrath, 1998) while using concrete manipulative "play" as a pedagogical strategy to aid in the development of mathematics conceptual understanding for young children (Brock & Rankin, 2008, p. 37; Stanberry, 2014). This method of symbiotic instruction of both reading and mathematics has been found to be an effective way to teach young children (Ferholt, & Lecusay, 2010; Siraj-Blatchford et al., 2002).

The reading and mathematics intervention being implemented in this study previously yielded positive results in enhancing children's interest in reading and mathematics vocabulary during a field study involving families implementing the intervention in their homes. However, it was unclear in the prior pilot study if the intervention would be appropriate in a classroom-like setting. Therefore, it was necessary to duplicate the study in a classroom context prior to inferring its classroom applicability in order to determine if this intervention could be used effectively in preschool classrooms by teachers. In order to preserve the ecological validity of the study (Palmer & Baroody, 2011), self-reported data were gathered from preschool

teachers. These teachers served as both implementers of the intervention plus observers of themselves and their preschool students. They were asked:

1. Does the symbiotic reading/mathematics intervention aid in developing oral language including math vocabulary?
2. Does the symbiotic reading/mathematics intervention lead to clearer understanding of early mathematical concepts?

Theoretical Framework

The theoretical constructs on which this study was framed were based on the interweaving of three previous research-based theories. First, this study relied on the premise that emergent literacy is based on social interactions between children and teachers, and that exposure to children's storybooks will also positively effect a child's vocabulary development (Sulzby, 1985, 1988; Sulzby & Teale, 1987; Valencia & Sulzby, 1991). Second, this framework relies on the theory of instructional congruence, which places subject area instruction as more relevant when presented through avenues that bow to student linguistic and cultural norms (Callaghan et al., 2011; Lee, 2002, 2004; Lee, & Fradd, 1998). Thus the intervention used in this study was developed with the inference that a child's linguistic norms can be experienced through the medium of children's storybooks and that a child's cultural norms include using food as manipulatives. Third, this study assumed that children would adapt their responses to the instructional intervention provided to them in their unique environments. We assumed that children in both environments could be successful attaining an early mathematics vocabulary and developing an understanding of early mathematics concepts as long as

the facilitators believed that students were capable of achieving those goals as they implemented the interventions. This is aligned with the Pygmalion Effect theory (Rosenthal & Jacobson, 1968, 1992; Appendix A). Therefore this study braided these theories (Callaghan et al., 2011; Lee, 2002; Lee & Fradd, 1998; Rosenthal & Jacobson, 1968, 1992; Sulzby, 1985, 1988; Sulzby & Teale, 1987; Valencia & Sulzby, 1991) as illustrated in Figure 2.

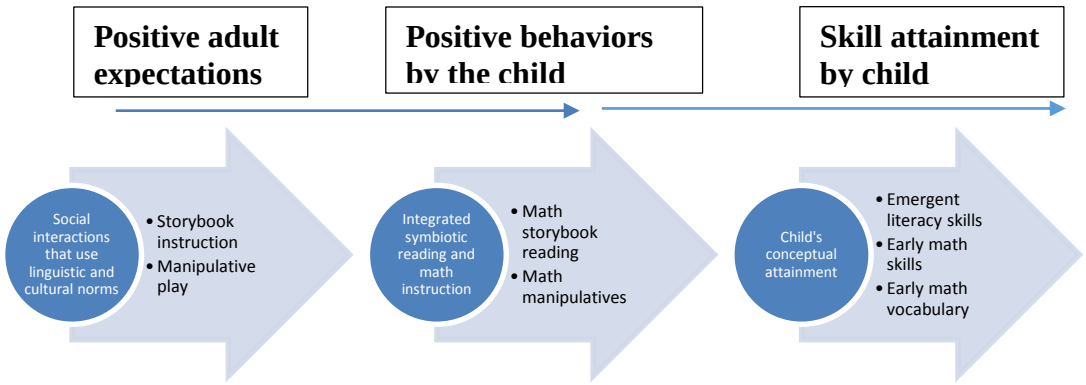

Figure 2.Theoretical framework for reading and mathematics symbiotic intervention (adapted from Callaghan et al., 2011; Lee, 2002; Lee & Fradd, 1998; Rosenthal & Jacobson, 1968, 1992; Sulzby, 1985, 1988; Sulzby & Teale, 1987; Valencia & Sulzby, 1991).

Methodology

Research Settings

The first implementation of the intervention in an early childhood classroom was conducted in a private daycare center (School A) located in a suburban community in the southwest region of the U. S. The second implementation of the intervention took place in a classroom-like setting of a common area found in a housing project situated in a southwestern urban community in the U. S. (School B). The site was chosen based on convenience to the researchers (Creswell, 2007) in addition to research interest. Researchers were interested in the applicability of the developed intervention treatment to populations of young children living in low socio-economic (SE), urban environments which would corroborate the instructional congruence of the intervention on enhancing children's reading/math development despite obvious differences in the children's resources and home environment.

Participants

Of the 15 teachers at School A, ten of them expressed an interest in completing the study. Shortly after the start of implementation, seven of the teachers withdrew from the study based on extraneous school commitments. Three of the original ten teacher volunteers completed the study including two Hispanic teachers and one Caucasian teacher. Two of the teacher participants were preparing for teacher certification but had little classroom experience and one teacher participant had earned her Associate's degree in child development yet had seven years of preschool classroom experience. All three teachers were female. Each teacher at School A was assigned to a different classroom.

Classrooms were distinguished by the children's ages. One teacher had the 12-18 month old classroom, one teacher had the 18-24 month old classroom and the last teacher had the 4-5 year old classroom.

Participants in School B included eight teacher volunteers who were already actively involved in a classroom like setting with preschool-aged children in the housing development. Some of these teachers were already college graduates while others were still finishing their studies at a university. Six of these teachers were male and two were female; four were Caucasian, two were African-American and two were Hispanic.

Intervention Training

The intervention is defined as four unique interactive shared reading/math experiences including suggested adult behaviors, storybook lessons and correlated mathematics activities (Appendix D). There were four unique lessons that formed the overall intervention. Each of these four lessons were presented to teachers at both School A and School B despite the differentiation in ages of children in their classrooms. Participants administered the same intervention that consisted of the four reading and mathematics integrated lessons to the preschool students they encountered regularly in their classroom-like settings during four separate meeting times. Teachers at School A and School B were provided specific coaching on how to implement the four lessons during a routine professional development. At School A the professional development for 10 of the 15 volunteer teachers involved in the study were provided with directions and ancillary materials. At the School B professional development, teachers had the opportunity to volunteer to be involved in the study and were provided with directions

and ancillary materials as well as monetary compensation equal to their normal pay for any extra time spent implementing the study (Godwin & Hubert, 2013). As part of their training, teachers were introduced to the main ideas that made each of the four lessons unique. Each lesson had a specifically denoted list of best reading practices to use when reading to children along with a list of suggested mathematics vocabulary to use during class and listen for with their children (see Appendix A). Additionally each lesson was created to allow for "teachable moments". Teachable moments are unanticipated turns in conversations that include addressing or clarifying other subjects that may arise during the lesson if such attention seems authentic and appropriate. Each lesson lasted approximately 60 minutes each-or, the time frame of a normal lesson for preschool-aged children

Instructional Instrument

. Teachers at both schools completed the pre-session Reading and Mathematics Perception Survey (Appendix E) to gauge what knowledge and implementation practices they already had organically established in their interactions with preschool-aged children prior to beginning the lessons that made up the intervention. Each lesson concluded with each teacher completing *The Reading and Math Perception Survey* (Appendix E) to gauge what knowledge and implementation practices they already had organically established in their interactions with preschool-aged children prior to beginning the intervention. This Likert scale survey instrument had four distinct forms that correlate to each of the four lessons that make up the intervention. The instrument was developed using the best practices for reading and mathematics integration that were

suggested in the joint position statement issued by The National Association for the Education of Young Children and the National Council of Teachers of Mathematics (2002). Surveys were based on the main ideas that formed each of the four unique lessons that made up the intervention. It is important to note that surveys were determined to be the best form of data collection in order to quickly gather responses from the multiple participants. In addition to providing quantitative information, the survey also gathered qualitative data in the form of a free response section at the bottom of each survey. Participants were encouraged to share their feelings about each lesson of the intervention including if they felt that the lesson was effective in aiding the development of oral language including mathematics vocabulary or if they felt the lesson aided with their students gaining a clearer understanding of early mathematics concepts. . We anticipated hearing about children using specific kinds of "mathematics vocabulary words" including numbers, quantity-words and others that were related to the stories in the interventions. Examples of the kinds of vocabulary words that previous studies had suggested parents use and that children later began expressing understanding of in their oral language as well are found in Appendix A. These words correspond to the words teachers were encouraged to use when they were conducting the four lessons of the intervention.

Instructional Application

Before teaching each lesson, teacher participants confirmed that they had all the necessary materials that had been provided by the researchers including a counting

storybook, a list of math behaviors to practice throughout each lesson, a coordinating snack for each student and a coordinating mathematics activity for each student.

At the beginning of each lesson, participants read a prescribed counting storybook with his or her preschool-aged students gathered around so that children were actively engaged in interacting with the math storybook, the teacher, and each other as the storybook was read. That is, students were encouraged to engage in conversation with the teacher and with each other about what they were reading in the counting book. The teachers had the option of engaging in "teachable moments" with children as questions came up in the reading (i.e. "Which of these numbers is larger?" could be used as a teachable moment to discuss early numeracy). At the conclusion of the counting storybook reading, participants distributed the coordinating snack and mathematics activity to each student and then supported each of their students so that they could effectively engage in the mathematics activity for the lesson. Mathematics activities included sorting, charting, graphing and comparing quantities of colorful snacks on color-coordinated placemat activity sheets. After concluding each lesson, each teacher completed the corresponding *Reading and Mathematics Perception Survey*.

Data Collection

Informal interviews were conducted at the conclusion of the study at School A and School B in order to gather insights from participants on the effects they perceived the concurrent, symbiotic reading/mathematics intervention to have on their students. Participants were informally interviewed by one of the researchers in order to gather information on each teacher's perception of the effectiveness of the lessons that made up

the integrated reading/math intervention. Interviews were initiated through informal questioning with responses being recorded verbatim for later coding and analysis.

Data Analysis

Qualitative analysis was used in both School A and School B through the information provided during semi-structured interviews. As previously mentioned although ten teachers volunteered to participate in the study at School A, only three completed the entire intervention with their students. Because of the mortality rate of participants in School A, a case study was conducted rather than using the Likert survey data with the remaining three teacher participants in order to focus on the effectiveness of the intervention (Casey & Houghton, 2010; Darke, Shanks, & Broadbent, 1998; Keen, & Packwood, 1995). Due to the limited time available with each teacher and the desire to gain authentic responses from the teachers at School A, informal interviews were conducted with the three remaining teachers to glean more information about how effective they perceived the intervention to be in aiding with oral language and early mathematics conceptual attainment.

The semi-structured interviews were conducted at School B consisted of open-ended questions that allowed for personalized responses that required more than a "yes" or "no" response while remaining informal enough to allow the participant to provide her/his perspective of the intervention (Ryan, Coughlan, & Cronin, 2009; Sallee, & Flood, 2012; Walsham, 1995). Because of School B having multiple participants, semi-structured interviews were recorded word-for-word for later analysis (Hubert & Godwin, 2013).

Instructional Instrument Implementation

Lesson One: The Goldfish Counting Book

Before the first lesson, teachers assured the researcher that they had all the necessary materials: the Pepperidge Farm Goldfish Counting Fun Book (McGrath, 2000a), list of math behaviors, sufficient colorful Goldfish crackers, a sorting mat, and sorting chart for each student. Each teacher read the Goldfish counting book with their students around them. This enabled the teacher to observe students placing Goldfish into specific spots designated in the counting book while scaffolding learning as the storybook was read.

The teachers were encouraged to engage in discourse with students asking questions (i.e. " How many Goldfish do we have when we add two more Goldfish to the book?"). This was used as a teachable moment to discuss different numerals and topics about number sense. After reading the Goldfish storybook, the teacher distributed servings of Goldfish to each student along with the corresponding mathematics activity for the day: a Goldfish sorting mat and chart. Teachers then asked students to arrange their Goldfish on the sorting mat and chart in order to facilitate mathematical learning experiences that were considered appropriate and significant to the students.

Lesson Two: The Cheerios Counting Book

Approximately one day lapsed between the first and second lesson as they were designed as typical preschool classroom lessons. Before starting the second lesson the researcher confirmed that teachers had all necessary materials: The Cheerios Counting Book, list of math behaviors to practice for this intervention, Cheerios for each student

and a Cheerios sorting mat for each student. Each teacher read the Cheerios counting book as the students stood surrounding him or her in order to observe students placing Cheerios into the counting book as the storybook was read.

Again teachers were instructed to scaffold their questions as they were reading such as "Is five greater than or less than four?" Sometimes these questions led to additional discourse leading to further instruction in order to facilitate the understanding of new mathematics vocabulary and concepts. After reading this storybook, each student was given a portion of Cheerios to sort using the provided sorting mat. The teacher directed students to arrange Cheerios on the mat according to the value indicated. For example, the placemat had different circles with the outline of Cheerios drawn inside of them with different numeric values outlining where to place that number of Cheerios. One circle had the image of two Cheerios along with the numeral "2" so that the concept of numeracy (Capraro, Capraro, & Jones, 2014; Godwin, Rupley, Capraro, & Capraro, 2015) was reinforced when the student placed the two Cheerios and saw the numeral on the placemat. These mathematical learning activities provided children with time to practice early number sense.

Lesson Three: The Froot Loops Counting Book

On the day following the second lesson, teachers instituted the third lesson of the intervention, first checking that all necessary materials for the intervention were available including the counting storybook, list of math behaviors for practicing the intervention, Froot Loops, and a Froot Loops graphing mat for each student. Next the teacher read the Kellogg's Froot Loops! Counting Fun Book to the students as they

stood around him or her while allowing students to place Froot Loops into the counting book as the storybook was read.

As with previous interventions, teachers were instructed to guide student understanding of the story as well as new vocabulary development through asking questions such as "Which color Froot Loop is first on the rainbow?" This question and others like it could lead to a class discussion on the concept of chronology, weather, geography, number sense, or other topics. After concluding the Froot Loops storybook and any subsequent discussion about the story, teachers began the activity portion of the lesson by distributing Froot Loops to each student along with a Froot Loops sorting mat. To conduct the activity, teachers instructed students to arrange their Froot Loops on the graphing mat in order to determine which color of Froot Loops each child had the most and least of. By facilitating mathematical learning experiences using graphing and sorting, teachers were given an avenue to nurture early mathematical conceptual attainment, setting a strong foundation for those children with regards to later mathematical learning.

Intervention Four: The M&M's Counting Book

The final day of the four-part intervention did not include instruction to teachers on specific symbiotic behaviors to practice during the lesson. Teachers were instructed to use those suggested symbiotic behaviors that seemed most natural or appropriate when conducting their last lesson. Before starting the concluding lesson teachers organized the needed materials: The M&M's Brand Chocolate Candies Counting Book, M&M's minis for each child and a M&M's graphing mat for each child. As with earlier

lessons, each teacher read the M&M's counting book to the students as they surrounded him or her so that the students could practice placing M&M's into the counting book where indicated as the storybook was read.

Although no specific symbiotic behaviors were suggested, teachers were still encouraged to ask mathematics-based questions to their children as the story was being read in order to further explore whether or not students had acquired any new expressive mathematics vocabulary. For example, it was suggested that words like greater than less than, or equal to (for other suggested words, see Appendix A) be used to start a mathematics-based dialogue with students as the story was being read. After the reading portion of the intervention, teachers distributed M&M's minis to each student along with an M&M's sorting mat so that students could again practice graphing and sorting, reinforcing lessons presented earlier in the series of interventions.

Findings

Because of the mortality rate on this project at School A, only three participants were able to complete the study. In spite of this low number of participants, which did not support quantitative analysis, the study yielded important data regarding preschool teachers' perceptions of preschool reading and mathematics lessons through the additional qualitative data collected. Despite the breadth of differences in the ages of the children in these preschool classrooms at School A, all three teachers responded that they wanted to help students learn both reading and mathematics concurrently. Teacher responses typically included an overall interest in how to better incorporate reading into mathematics and mathematics into reading instruction in their classrooms. All three

teachers agreed that they had never considered the classroom discourse that they had as having an impact on their students' conceptual understanding, but felt their increased awareness of the use of these discussions in their classroom helped them become better teachers. These data provide further evidence that the symbiotic reading/mathematics intervention aided in developing oral language including math vocabulary as was posed by research question one. It is of note that the teacher of the youngest group of children, ranging in age from 12-18 months, reported on her survey that "these interventions did help the children with recognizing numbers." In other words this intervention could have provided important information for teachers of young children on how to begin instruction on early numeracy providing further evidence of the reading/mathematics intervention aiding in the development of early mathematics understanding as well as the development of oral language including math vocabulary. The teacher of the next oldest group, 18-24 month old students reported on her survey that she "hadn't thought of addressing mathematics with children this age before but found that students enjoyed mathematics storybooks and activities". Although this observation does not directly answer either of the proposed research question because it does not specify if there was evidence of the development of oral language or of a new understanding of early mathematics concepts, it does indicate that these lessons provided a medium for children to become exposed to fun reading experiences while listening to and engaging in mathematics vocabulary through concrete manipulatives and storybooks. The third teacher whose students ranged from four to five years old suggested that these interventions were too easy for her students because of their previous exposure to

specific mathematics instruction in her classroom. Because the third teacher did not find evidence of development of new oral language or new understanding of mathematics concepts it is feasible to conclude that this set of symbiotic lessons was not an appropriate for the age of the children in her classroom. Still, she did note that the lessons provided an area for her to start discussions about mathematics and that through extensions of the prescribed intervention she was able to adapt and construct valuable lessons for her students by using the materials that were provided by researchers.

It is of interest that the teachers involved in this study at School A were mostly interested in helping their children. Teachers were enthusiastic but ambiguous in self-reports to the researchers. The anticipated vocabulary set that we thought would be reported by teachers (as listed in Appendix A) as children experienced the interventions was never specifically addressed by teachers at School A. In other words, although teachers said that their students started to use mathematics vocabulary words, the new words that teachers reported students now using were not clearly outlined to the researchers.

School B yielded similar positive results without participant mortality. All teachers at School Breported that using mathematics storybooks as a medium of instruction with preschool-aged children yielded positive results in the areas of early numeracy and enhancing math interest. One teacher even reported that she started to hear the children comparing quantities with each other using terms like “greater than” and “less than”. This implies that not only were students increasing their use of mathematics vocabulary, but they were also beginning to exhibit interest in mathematics

in general through actively participating in the lessons and asking questions. This also confirms an increase in the use of previously identified mathematics vocabulary that correlates to these interventions (Godwin, 2013, Appendix A). According to these teachers most students had very little exposure or understanding of numerals, number sense, or print awareness in general prior to these interventions but that children always seemed "enthusiastic…like they wanted us to read another book". Experiencing these kinds of reading and mathematics integrated lessons added both interest and intellectual capital in the forms of both oral language development as well as in foundational mathematical understanding. All teachers at School B attested that this kind of approach to addressing numeracy with young children created a good foundation for future learning. They recognized that the symbiotic nature of the intervention allowed for students to "get more" out of lessons than if either reading or mathematics was presented in a one-dimensional manner. One teacher even expressed curiosity in the long-term impact of continued exposure to integrated, symbiotic lessons like those presented in the intervention. She inferred that with more exposure to numerals in math storybooks children would continue to develop their numeric number sense understanding as well as print awareness. She reported that "We have seen progress in a small amount of time, so I would love to see how much progress will be made in a long time of the students engaging in these activities".

Limitations

This study was introduced and then conducted in School A during the fall season

and the implementation of the interventions coincided with the start of the holiday season. It is possible that outside factors such as practicing for school holiday programs could have contributed to the initial enthusiasm and then subsequent falling off of participants from the study. It is also possible that the teacher of four to five year old students at School A had a natural propensity toward mathematics instruction so she felt the treatment did not challenge her students. It is also possible that so many teachers initially volunteered to participate in the study in order to receive the ancillary materials that were provided at the workshop when the study was introduced, so coercion could have been another factor contributing to the inflated number of volunteers to originally participate in the study at School A. Meanwhile there was an economic motivator keeping participants at School B involved in the study until its completion, yet those teachers seemed to provide more specific information during the reflection portion of the study providing researchers with more insights about the perceptions of the teachers about the impact of the intervention with their particular student population.

Conclusions

Different locations for the two studies included in this research allowed for both geographically as well as economically diverse settings. Although this data was limited due to a small number of participants, data presented indicate positive results when examining teacher perception of the intervention. Teachers at both schools reported that the children that were exposed to the symbiotic concurrent reading/mathematics instruction benefited from the treatment These data further substantiate the claim made

by earlier researchers that children will acquire the foundational skills they are exposed to within their community environment when the skills are presented using linguistic and cultural norms that the child is accustomed to in a social setting (Callaghan et al., 2011; Lee, 2002; Lee & Fradd, 1998). Findings also support the Pygmalion effect (Rosenthal & Jacobson, 1968, 1992; Appendix C) that argues children will adapt to the expectations set forth to them by adults with regards to behavior and skill attainment. Additionally it is of note that all teacher participants agreed that this intervention yielded positive effects on their students' mathematics interest and/or vocabulary development adding more evidence to similar claims made by earlier studies (Sulzby, 1985, 1988; Sulzby & Teale, 1987; Valencia & Sulzby, 1991).

In order to support a more informed argument on the universality of the positive benefits resulting from concurrent symbiotic reading/mathematics instruction, further research involving a larger population of preschool teachers would be needed. Extension studies could be conducted using more teacher participants in a longitudinal model to corroborate findings and assumptions made by these studies. Other suggestions for future study would be to include the Preschool World and Print Awareness model (Justice, Bowles, & Skibbe, 2006) in tandem with the intervention suggested by this study in order to measure whether at risk children could also experience further advancements through both reading and mathematics concurrent instruction. These extensions could provide further information on the areas of interest that young children find in the areas of reading and mathematics through exposure to both during concurrent reading/math experiences provided through this small study.

In conclusion, this study examined the effectiveness of a symbiotic, integrated intervention when used in preschool classroom settings. It was determined that these interventions could provide positive experiences for preschool children. Teacher interest was developed with regard to developing strategies to integrate reading and mathematics instruction for their children. Thus improvements in instructional awareness and student interest in mathematics and vocabulary development was achieved in both School A (Godwin, 2013) and School B (Godwin & Hubert, 2013).

CHAPTER V

CONCLUSIONS

There has been an increased research interest in researching preschools during recent years. This concern was initially expressed in the No Child Left Behind legislation (2002) and catalyzed during Barack Obama's State of the Union address (2013). Community leaders, stakeholders, and even the President have begun addressing foundational learning as an area that needs growth because international comparison studies have pointed out that the United States has consistently had an unimpressive rank in both reading and mathematics (OECD, 2003, 2013). It is the hope that giving special attention to the curriculum of the young learner will lead to all children starting formal schooling with a more refined skill set leading to positive growth in international comparisons among other things.

Because the areas of reading and mathematics have been highlighted as growth areas for students in the United States, policy makers should begin to consider symbiotic instruction as a means of enhancing development in both areas starting with preschoolers. The purpose of the research conducted during this dissertation study was to add further evidence concerning the benefits of concurrent instruction of reading and mathematics with young children, particularly in the area of mathematics vocabulary development. The first study was a meta-synthesis, conducted in order to seek justification for the development of a symbiotic reading and mathematics intervention. The second study was conducted to determine whether or not the developed symbiotic intervention was perceived to effectively nurture both reading and mathematics

development in young children when applied in the home. The third and final study of this dissertation applied the reading and mathematics interventions in two classroom settings for preschool students: one urban and one suburban to determine if the intervention was perceived to be effective.

The first study, a meta-synthesis, was conducted in order to justify the development of a symbiotic reading and mathematics intervention. This review of the literature investigated the factors contributing to a child's ability to communicate and the effect of symbiotic reading and mathematics integration on a young child's ability to think and communicate mathematically. Relevant literature was identified using key words: toddlers, dialogs (language); picture books; language acquisition; reading aloud to others; parent child relationship; reading motivation; mathematics). Three duplicate artifacts were identified that subsequently eliminated three of the original artifacts so only 576 artifacts remained for inclusion. An appraisal tool with refined key words was developed to aid in the evaluation and elimination of irrelevant literature in the 576 artifacts. In order to be included in the meta-synthesis, each artifact had to contain either the word "toddlers" or the word "preschoolers" and one of the following terms: discourse, language, relationships, development in reading or development in mathematics. After a two round elimination process, 25 artifacts were determined to be appropriate for inclusion in this meta-synthesis. Two over-arching themes were identified in the remaining, relevant literature: factors contributing to a child's ability to communicate (socio-cognitive behaviors, bioecological factors) and dialogic reading. Additionally, two important studies were identified after reviewing the literature. Doyle

and Bromwell (2006) attest that the discourse involved in storybook readings with children is a critical factor in helping the child gain knowledge and understanding of what is happening in the story. In fact, they claimed that it is not only what we read to a child but how that influences the child's verbal and communicative development. Anderson and colleagues (2004) conducted groundbreaking research on the effects of reading and mathematics symbiotic treatments. Their studies infer that a child experiencing such treatments could begin to internalize mathematics understanding, process that understanding and then be able to verbalize their understanding in order to communicate "mathematically". However, the study by Anderson and colleagues (2004) that attempted to illustrate such a phenomena was the only foundational study of its kind that was uncovered in this meta-synthesis. Therefore, further research illustrating the potential outcomes associated with a symbiotic reading and mathematics treatment is needed. The results of the meta-synthesis justified further research.

In order to determine the effects of reading and mathematics symbiotic instruction, a curriculum needed to be developed and from that an intervention needed to be created. The curriculum developed for the next two studies was created and adapted by considering the joint position statement from the National Council of Teachers of Mathematics and the National Association of Educators of Young Children (2002) that outlined ten "best practices" for adults to use in order to promote the development of foundational reading and mathematics for their children. Those behaviors were then presented in tandem with research based family literacy activities (DeBruin-Parecki, 1999) as well as a prescribed hands-on mathematics curriculum "Hands-on-math

strategies: Edible Math-Primary" (Kinney, 2008). An intervention was adapted with consideration for those previous studies. The intervention was divided into four lessons that made up an integrated reading and mathematics intervention. Each lesson included specific behavioral goals for parents (NAEYC & NCTM, 2002) and a mathematics storybook (DeBruin-Parecki, 1999) as well as a food manipulative and early mathematics manipulative skill builder such as sorting or charting (Kinney, 2008).

The theoretical framework for the second and third studies conducted in this dissertation was adapted from Sulzby (1985, 1988) and Rosenthal and Jacobson (1968, 1992). Sulzby (1985, 1988) contested that children begin to exhibit early literacy behaviors long before actually becoming what is considered "literate". For example, children will try to tell a story based on pictures or sometimes memory "pretend reading" before they are able to truly know how to decode and comprehend the words written on pages. Furthermore, it was hypothesized that if adults perceived their children could learn early reading behaviors and early mathematics behaviors through the application of the prescribed interventions, then the children would begin to exhibit qualities that would show that they were beginning to learn early reading and early mathematics skills. It is understandable then that the "Pygmalion effect" of Rosenthal and Jacobson (1968, 1992) was also a part of the theoretical framework for these studies. The Pygmalion effect states that when an adult has certain expectations for a child that the child will then change their behavior to satisfy what is expected of them. In other words, the child will do what they are expected to do. In these studies, the adult was told

to expect that the child was able to learn early reading and mathematics skills through the prescribed symbiotic interventions.

Data from the second study of the dissertation reported the perceived effectiveness of the four lessons that were developed to make up the intervention when utilized in the home by parents. Parents and children came to four distinct, come-and-go workshops in order to learn about how to conduct the lessons of the intervention in their homes. Participating families were provided with materials and returned the next week to report on their perceived effectiveness of the lesson. These parents reported positive developmental reading and mathematics effects as a result of the utilization of the lessons. Although there were extremely limited findings due to such a small number of participants, the data that was collected were overwhelmingly positive. Parents most notably commented on the excitement they felt in helping their children develop both reading and mathematics skills symbiotically and concurrently. The most interesting finding was how open to the reading and mathematics intervention the parents were. Through allowing parents to be a part of the research process, the parents gained confidence not only in their child but also in their role as the child's "first teacher". The development of further school-to-home activities could help create an early, tangible bridge between learning at school and learning at home.

Daycare centers could become a hub for future home studies like this one. These future home studies should be developed using a simple curriculum that is easily applied with clear instructions that are then distributed to parents to help them implement activities in their homes. It is also suggested that ancillary materials be provided to

future study participants during training sessions as this allows for practice time of the suggested experiences with the researcher in order to seek clarification. Future studies should also take into consideration the willingness of parents to participate in such studies if flexibility exists for those parents' schedules. It is suggested that future home treatment studies initiated in daycare centers provide unique, efficient individualized training sessions for participants in order to not only implement the treatment of the study but to also build a relationship with participants. When participants are comfortable with researchers and feel valued in the research process it is more likely that they will provide quality data as they are then a co-constructer of the research.

It was also notable that all parents reported that their children responded well to the treatment. One could infer that this was because there was an underlying assumption communicated to parents that their children "could do it". When children were put to task with the treatment: engaging in mathematics activities and mathematics dialogue it was because their parents believed that they could do those things. The results of this study add further evidence that the Pygmalion effect (1968, 1992) has relevance with regards to parental expectations and children's educational outcomes.

The third study was conducted in order to determine if the developed intervention would also yield the same positive results when applied in a classroom environment for preschoolers. Teachers from two different schools (suburban and urban) were part of the study. Teachers at both research sites reported evidence that there were positive reading and mathematics effects due to the application of the interventions. The biggest limitation to this study was also a small number of participants. Although only

three teachers participated at one school and eight participated at the other school, there was a positive response to the intervention reported from all teachers. The training required for teachers to implement these interventions was minimal yet the data provided by teachers indicated this intervention was a powerful way to begin introducing early reading and mathematics skills to young children in a way that provided real benefits. What makes this finding so dynamic is the knowledge that simple instruction followed by the application of the intervention led to a positive result in children of both classroom environments.

Through discovering positive commonalities in children's responses to this intervention via two very different daycare settings, some exciting inferences can be drawn. For example, it is interesting that all teachers reported that children were more excited about both reading and mathematics because of the implementation of the symbiotic reading and mathematics interventions. It was also very interesting to note that teachers with students even as young as 12 months reported positive outcomes as a result of the implementation of the intervention. With that in mind, one must consider that each intervention session included a counting storybook, an early mathematics activity (such as sorting or counting), and a snack that was used as a manipulative during the intervention. Those elements were chosen because of the culturally relevant appeal that those items have to children transitioning from infancy to becoming toddlers. Still, this study was very limited in its findings due to a minimal amount of data collected. A future vertical study involving the tripartite formula used in this study could begin to be the basis of a curricular framework that could be adapted for children using different

mathematics based storybooks that are not just about counting. As children grow and learn more content, the mathematics storybooks and mathematics activities that are used in the intervention could center on more sophisticated mathematical concepts such as fractions or geometry. The extrapolation of this kind of intervention for children in formal schooling is almost infinite and could provide value in today's high stakes testing classrooms as another way to instruct through multi-modal learning. Vertical studies recording the effects of this phenomena could provide powerful data on the positive outcomes that could be seen as a result of progressive reading and mathematics integrated instruction.

In order to corroborate the data found in these studies (Godwin, 2013, 2015; Godwin & Hubert, 2013) it would be necessary to conduct further longitudinal studies using both family studies and daycare classroom studies to determine if in fact the interweaving of early mathematics skills and reading skills leads to higher academic achievement for students once they begin a formal education. This additional research would be a dynamic study to provide further support of the theory that these skills in both reading and mathematics are not necessarily independent of one another, but rather symbiotic. By incorporating symbiotic interventions in preschools or encouraging such practices through family intervention workshops, children may become more familiar with mathematical concepts and vocabulary early in their lives that could lead to a future with increased academic outcomes. The practical implications of the broad field implementation of a symbiotic reading and mathematics intervention have great potential for those working with young children. Children who experience a more

fulfilling shared reading experience may also experience better social interactions at school due to increased confidence in reading and communication. Additionally, providing a solid foundation for future learning through the utilization of reading and mathematics symbiotic interventions could improve the quality of the workforce, and the post-secondary matriculation rate.

Other areas of interest for further research include more specific studies on elements of the curricula adapted from the joint statement that were outside the area of this study. For example, according to the joint position statement (NAEYC & NCTM, 2002) (Appendix D) culture and community can play a role in reading and mathematics attainment, particularly in early children. However, there was no data collected in this study that indicated "culture or community" necessarily be factors that contributed to the reading or mathematics development in these interventions. Still it could be inferred that children that were exposed to the interventions either through the family study or through the classroom based intervention study were providing data about a culture and a community just by participating in the study. Still, future studies could explore best practices for making mathematics and reading culturally relevant for children through regionally directed, culturally diverse, or linguistically directed activities or storybooks. For instance, in southwest Texas early mathematics storybooks could be written dually in English and Spanish in order to respect the unique cultural make-up of the region. Future areas of study could focus on recognizing and celebrating the impact that culture can have on a child's ability and interest in learning more about reading and mathematics.

Although the research conducted during this dissertation study was accomplished through the lens of educational research, the findings may be of interest to those in the fields of psychology and sociology. Studying patterns of behavioral development and the impact of bioecological factors (Bronfenbrenner, 1994) on a child's development are common research themes that can lead to an increased understanding in the development of a child's communicative competence. The current studies used the Pygmalion Effect Theory (Rosenthal & Jacobson, 1992) to justify the idea that parent perception of a child's ability can be an enhancing factor in a child's skill attainment. Data collected provide strong evidence to support this theory when applied to a skill attainment condition.

In order to justify the development of more programs that symbiotically integrate reading and mathematics, this research study and similar studies are critical. Interventions such as those discussed in chapters two and three of this dissertation could enhance children's interest in reading and mathematics. Additionally, these interventions could also lead to enhancing inner personal dialogues through the increase in communicative emphasis during shared reading time, the building of relationships and the development of a community of lifelong learners.

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APPENDIX A

Catalog of preschool mathematics vocabulary

Numerals 1, 2, 3…)
Sort
Graph
Count
Add
Subtract
Circle
Square
Triangle
Chart
Compare
Octagon
Greater than…
Less than…
Equal to…

APPENDIX B

Examples of artifacts eliminated from meta-synthesis

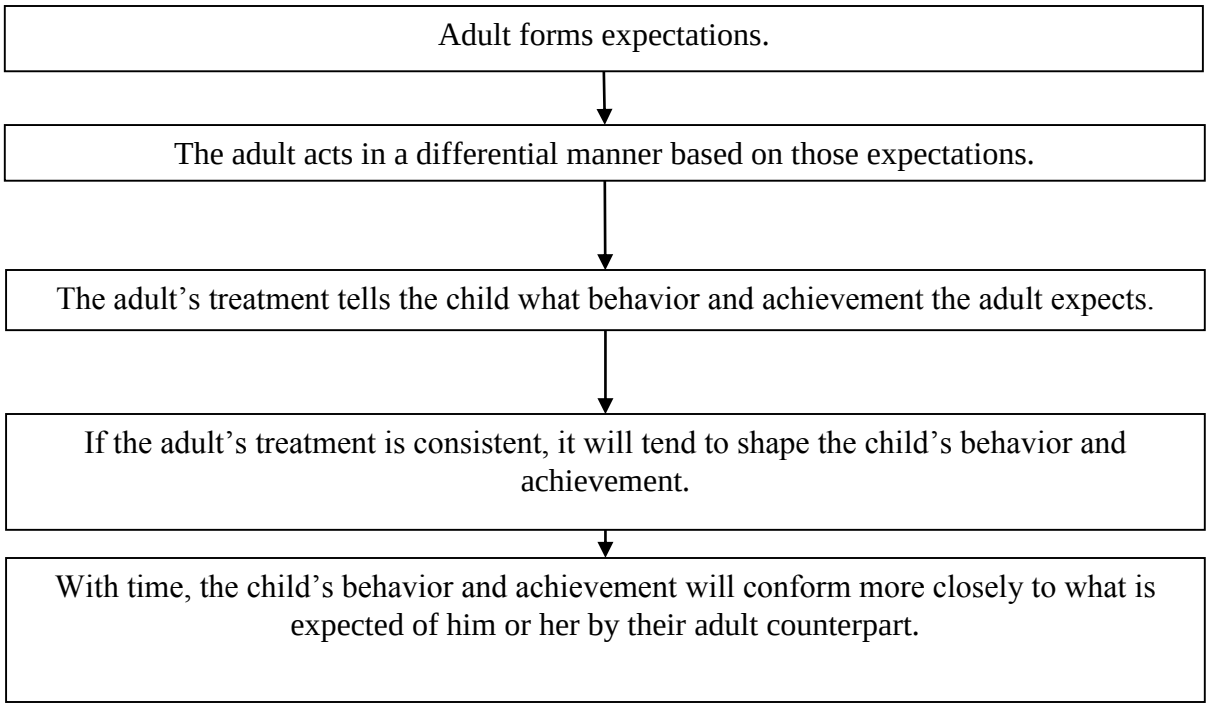
	Unrelated central issue addressed in article	Article
Round One	• Deaf education	Mayer, C., Akamatsu, C. T., Stewart, D. (2002). A model for effective practice: Dialogic inquiry with students who are deaf. *Exceptional Children*, *68*(4), 485-502.
	• Bilingual education	Martinez-Roldan, C. M. (2005). The inquiry acts of bilingual children in literature discussions. *Language Arts*, *83*(1), 22-32.
	• Regionally specific research outside the United States	Karakhanyan, S., vanVeen, K., & Bergen, T. (2011). Educational policy diffusion and transfer: The case of Armenia. *Higher Education Policy*, *24*(1), 53-83.
	• Research on elementary-aged students	Baker, S. K., Santoro, L. E., & Chard, D. J. (2013). An evaluation of an explicit read aloud intervention taught in whole-classroom formats in first grade. *Elementary School Journal*, *113*(3), 331-358.
Round Two	• Reading and mathematics storybook instructional research in international studies	Mol, S., Bus, A., deJong, M., & Smeets, D. (2008). Added value of dialogic parent–child book readings: A meta-analysis. *Early Education & Development*, *19*(1), 7-26.

	• Attachment parenting	Jaffe, J., Beebe, B., Feldstein, S., Crown, C. L., Jasnow, M. D., Rochat, P., & Stern, D. N. (2001). Rhythms of dialogue in infancy: Coordinated timing in development. *Monographs of Society for Research in Child Development, 66*(2), i-viii, 1-149.
	• School policy	Pomerantz, E. M., Moorman, E. A., & Litwack, S. D. (2007). The how, whom, and why of parents' involvement in children's academic lives: More is not always better. *Review of Educational Research, 77*(3), 373-410.

APPENDIX C

Pygmalion effect table

(Adapted from Rosenthal & Jacobson, 1968, 1992)



APPENDIX D

Creating a Pro-Reading and Pro-Mathematics Home Environment Training Sessions Outline

(Adapted from DeBruin-Parecki, 1999; Kinney, 2008; NAEYC & NCTM, 2002; Stanberry, 2014)

	Intervention 1. *The Goldfish Counting Book*	Intervention 2. *The Cheerios Counting Book*	Intervention 3. *The Froot Loops Counting Book*	Intervention 4. *The M&M's Counting Book*
Survey	Pre-intervention survey	Intervention 1.	Intervention 2.	Intervention 3. Post session: Intervention 4. Ending survey
Family based adult/child curricula	1. Enhance children's natural interest in mathematics and their disposition to use it to make sense of their physical and social worlds. 2. Build on children's experience and knowledge, including their family, linguistic, cultural and community backgrounds. 4. Use dialogue to strengthen children's problem-solving and reasoning processes as well as representing, communicating, and connecting mathematical ideas.	6. Provide for children's deep and sustained interaction with key mathematical ideas. 8. Provide ample time and support for children to engage in play, a context in which they explore and manipulate mathematical ideas with keen interest. 10. Support children's learning by thoughtfully and continually assessing all children's math knowledge, skills strategies.	3. Change how you address mathematics based on your child's ability. 5. Ensure that books are compatible with known relationships and sequences of important math ideas. 7. Integrate math with reading and reading with math. 9. Actively introduce math concepts, methods, and language through a range of experiences and reading.	Review behaviors 1-10
Activity	1. Goldfish sorting mat 2. Goldfish chart	Cheerios sorting mat	Froot Loops charting mat	M&M's charting mat

APPENDIX E
Adult Surveys
(Adapted from NAEYC & NCTM, 2002)

Reading and Math Perception Survey **Intervention 1 Pre-survey**

Directions. Please mark the following according to what most appropriately describes your family shared reading practice.

1. I give my child(ren) a chance to touch the book and turn the pages.
    a. Almost always
    b. Sometimes
    c. Once in a while
    d. Rarely
    e. Never

2. I ask questions to my child(ren) about the story.
    a. Almost always
    b. Sometimes
    c. Once in a while
    d. Rarely
    e. Never

3. I identify pictures in the book that are related to the story.
    a. Almost always
    b. Sometimes
    c. Once in a while
    d. Rarely
    e. Never

4. I emphasize repeated words in the story.
    a. Almost always
    b. Sometimes
    c. Once in a while
    d. Rarely
    e. Never

5. I relate the story to personal experiences.
    a. Almost always
    b. Sometimes
    c. Once in a while
    d. Rarely
    e. Never

6. I use hand motions to demonstrate numbers when reading a counting story.
    a. Almost always
    b. Sometimes
    c. Once in a while
    d. Rarely
    e. Never

Comments:

Reading and Math Perception Survey **Intervention 1**

Directions. Please mark the following according to what most appropriately describes your family shared reading practice.

1. By reading mathematics storybooks, I have found ways to enhance my child(ren)'s natural interest in math and their desire to use it to make sense of their physical and social worlds.
    a. Agree
    b. Somewhat agree
    c. Neither agree nor disagree
    d. Rarely
    e. Never

2. I ask questions to my child(ren) about the story.
    a. Almost always
    b. Sometimes
    c. Once in a while
    d. Rarely
    e. Never

3. I identify pictures in the book that are related to the story.
    a. Almost always
    b. Sometimes
    c. Once in a while
    d. Rarely
    e. Never

4. I emphasize repeated words in the story.
    a. Almost always
    b. Sometimes
    c. Once in a while
    d. Rarely
    e. Never

5. I relate the story to personal experiences.
    a. Almost always
    b. Sometimes
    c. Once in a while
    d. Rarely
    e. Never

6. I use hand motions to demonstrate numbers when reading a counting story.
    a. Almost always
    b. Sometimes
    c. Once in a while
    d. Rarely
    e. Never

Comments:

Reading and Math Perception Survey **Intervention 2**

Directions. Please mark the following according to what most appropriately describes your family shared reading practice.

1. By reading math storybooks, I am able to provide ways for my child(ren) to continually interact with key math ideas such as counting.
    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree

2. By reading math storybooks, I am able to provide ways for my child(ren) to continually interact with numerals (examples: 1, 2, 3).
    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree

3. By using supplemental math activities that compliment math storybooks, I am able to encourage my child(ren) to play in a way that encourages exploration and manipulation of math ideas. Strongly agree
    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree

4. By using supplemental math activities that compliment math storybooks, I am able to provide ways for my child(ren) to continually interact with key math ideas such as counting.
    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree

5. By using supplemental math activities that compliment math storybooks, I am able to provide ways for my child(ren) to continually interact with numerals (examples: 1, 2, 3).
    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree

Comments:

Reading and Math Perception Survey **Intervention 3**

Directions. Please mark the following according to what most appropriately describes your family shared reading practice.

1. By reading math storybooks to my child, I have found ways to enhance my child(ren)'s natural interest in math.
    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree

2. By reading math storybooks to my child, I am able to build on my child(ren)'s experience and knowledge.
    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree

3. By reading math storybooks to my child(ren), I am able to connect math to our family, culture or community backgrounds.
    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree

4. We discuss what we read in math storybooks in order to strengthen my child(ren)'s problem-solving skills.
    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree

5. By reading math storybooks to my child(ren), I find myself including representing, communicating, and connecting math ideas to practical experiences.
    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree

Comments:

Reading and Math Perception Survey **Intervention 4**

Directions. Please mark the following according to what most appropriately describes your family shared reading practice.

1. I find that I change the way I talk about math based on my child(ren)'s ability.
    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree

2. I have found that math storybooks are compatible with math ideas that my child(ren) knows.
    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree

3. It is easy to integrate math with reading and reading with math during family shared reading time.
    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree

4. I have started to actively introduce math concepts, methods, and language through a range of math experiences.
    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree

5. I have started to actively introduce math concepts, methods, and language through math storybook reading.
    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree

6. I support my child(ren)'s learning by continually assessing my child(ren)'s developing early math knowledge.
    a. Strongly agree
    b. Agree
    c. Neither agree nor disagree
    d. Disagree
    e. Strongly disagree

Comments:

Reading and Math Perception Survey **Ending survey**

Directions. Please rank the following behaviors according to what you perceive to be the most beneficial behavior to enhance your child(ren)'s engagement in both reading and math. Please indicate the behavior that you think is most important with "1" and continue to rank the next most important behaviors until you reach 14, the least important behavior.

_____ Enhancing my child(ren)'s interest in math through reading math storybooks.

_____ Reading math storybooks to my child(ren) in order to build on my child(ren)'s experience and knowledge.

_____ Reading math storybooks to my child(ren) in order to connect math to our family, culture or community background.

_____Discussing what we read in math storybooks in order to strengthen my child(ren)'s problem-solving skills.

_____ Reading math storybooks to my child(ren) in order to connect math ideas to practical experiences.

_____ Reading math storybooks in order to provide ways for my child(ren) to continually interact with key math ideas such as counting.

_____Reading math storybooks in order to provide ways for my child(ren) to continually interact with numerals (examples: 1, 2, 3).

_____ Using supplemental math activities that compliment math storybooks, I am able to encourage my child(ren) to play in a way that encourages exploration and manipulation of math ideas.

_____ Changing the way I talk about math based on my child(ren)'s ability.

_____ Finding math storybooks are compatible with math ideas that my child(ren) knows.

_____ Integrating math with reading and reading with math during family shared reading time.

_____ Actively introducing math concepts, methods, and language through a range of math experiences including math activities that complement math storybooks.

_____ Actively introducing math concepts, methods, and language through math storybook reading.

_____ Supporting my child(ren)'s learning by continually assessing my child(ren)'s developing math knowledge.